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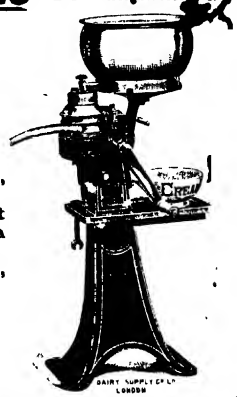

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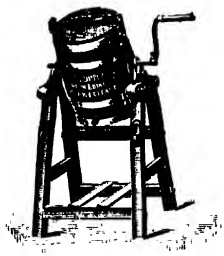

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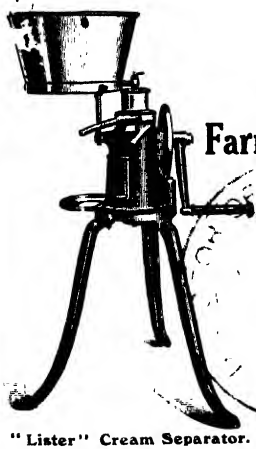

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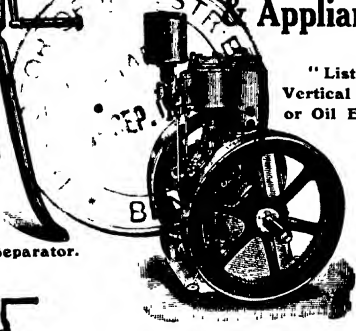

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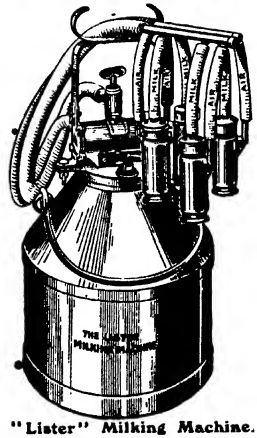

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PRACTICAL CHEESEMĀKING

PRACTICAL CHEESEMAKING

A GENERAL GUIDE TO THE MANUFACTURE OF CHEESE

BY

C. W. WALKER-TISDALE

AND

WALTER E. WOODNUTT

LONDON

HEADLEY BROS. PUBLISHERS, LTD.

72, OXFORD STREET W.1.

1919

"**Dairy World.**"—The authors of this book are modest in their pretensions, but an examination of their work shows that it has been undertaken with a thoroughness and completeness which will assure for it a position as a standard authority on the subject.

. . . We can confidently recommend it as a good investment, as there can be no question about a person being a better cheesemaker for the valuable knowledge derived from this work.

"**The Field.**"—Messrs. C. W. Walker-Tisdale and W. E. Woodnutt have placed at the service of cheesemakers just the sort of book they need and will appreciate. It was prepared by practical cheesemakers for others who may have had fewer opportunities for testing the teachings of science, and the latest results are set forth so that the average maker will interpret without difficulty.

"**Nature.**"—The subject matter is well chosen, and whilst the explanations which are given at each stage are clear and simple, there is a great deal of practical information which it has previously been difficult to obtain in print.

The chapter treating of starter is a particularly good one, from both the theoretical and the practical points of view.

. . . the best known British varieties are dealt with in detail. This portion of the book is to be strongly recommended, for the author's wide practical experience is drawn upon with the best results.

"**The Bazaar, Exchange and Mart.**"—The authors are not only capable writers, but practical men, and they have dealt with almost all those branches of the subject upon which cheesemakers need information. The book is well illustrated and printed in large clear type. There is an excellent index, while the list of contents is most helpful to the reader.

"**Irish Homestead.**"—We recommend every creamery manager or farmer who has thoughts of cheesemaking to procure a copy of this admirable manual . . . it ought to be on the bookshelf of every creamery manager or large dairy farmer.

"**Irish Times.**"—The authors . . . have produced a simple text book in which they have succeeded in embodying most of the practical points essential to the manufacture of cheese on the best and most economical lines.

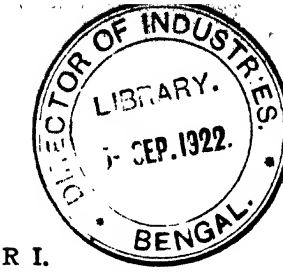
PREFACE TO REVISED EDITION

THIS book, first issued in October 1917, has met with such a ready reception that a large edition has been entirely sold out in the course of a few months, and a new edition is now necessary.

"Practical Cheesemaking" is issued as a simple text book, making no pretence to deal with the subject exhaustively, but embodying most of the practical points of information for those who wish to manufacture cheese on the best and most economical lines.

The necessity of increasing the food supplies of the country has been brought home to us by the submarine warfare, and the fact that milk, converted into cheese, forms one of the best keeping and most nourishing of foods obtainable, has directed considerable attention to the cheesemaking industry.

The production of cheese in this country is being greatly increased, and this should go a long way towards meeting the deficiency in supplies from the Colonies and abroad.



CHAPTER I.

THE DAIRY BUILDING AND ITS ARRANGEMENTS.

THE Cheese-making dairy should contain at least four compartments —(1) The dairy wherein the cheese is made. (2) A cheese-ripening room. (3) A scullery for washing up the utensils and cheese cloths. (4) A boiler house and coal store.

In addition to the above compartments, large dairies and cheese factories usually have: (a) A milk-receiving platform. (b) A milk testing room. (c) A cheese drying room if necessary, which will depend upon the kind of cheese manufactured. (d) An office.

In order that cheesemaking may be carried on successfully, besides having the building suitably constructed, it is most essential that the sanitary conditions should be good. The following underlying principles must receive careful attention before building a new dairy or making alterations to an old one.

(1) Situation and Design of Dairy.

(1) The dairy should be situated away from the dwelling house, farmyard, piggeries, poultry houses, and from any cesspools or sewage tanks in connection

therewith. Freedom from dust and smells is a very important point. (2) It is desirable that the dairy should be built on a healthy, open and somewhat elevated site for the following reasons: (a) To prevent contamination by surface water through soakage. (b) To convey the whey to piggeries or elsewhere by means of open troughs or channels. The use of pipes is not to be recommended, as it is a difficult matter to keep them clean. (c) To ensure a circulation of pure air around the dairy and permit the draining of the ripening room when underground, which otherwise might prove a difficult matter. (3) Study economy and convenience in working, so that the work, especially the cleaning, may be carried out with a minimum amount of labour. (4) Provide as far as possible for equability of temperature in the dairy, plenty of light and efficient ventilation. If possible, windows should be arranged in opposite walls and the heads of the windows carried up as high as possible. By this means through ventilation is obtained and better lighting secured to those portions of the Dairy furthest removed from the sources of light. (5) Study economy in construction, have a good water supply, and an efficient drainage system. Carry the drains in straight lines as far as possible, but wherever a change of direction is necessary provide an Inspection Chamber.[4] Be careful to see that the drains are laid to regular gradients. Foul water drains or those conducting dairy sewage should be laid on concrete and all joints should be made to withstand the "water test."

(2) Materials and Construction.

In districts where there is a plentiful supply of stone available, and bricks are scarce, the dairy is usually built of stone. In this case solid stone walls are constructed for the whole of the building. Stone walls are built about 18 inches to 2 feet thick. Bricks are preferable to stone, as double walls can be constructed without much difficulty. An 11 inch cavity wall makes a very suitable outer wall for a one-storey building, but the outer lining of brickwork should always be built in cement mortar. For a building over one storey in height it is not advisable to have anything less than a 14 inch brick wall or a 16 inch cavity wall. It should be borne in mind that an 11 inch cavity wall is hardly suitable for bolting machinery or shafting to.

Solid brick piers or buttresses should be built where necessary in such cases.

The cavity walls are an admirable arrangement for guarding against extremes of heat and cold.

All walls should have a good damp course built in immediately above the ground level and yet below the floor level.

A damp course of Bitumen is possibly one of the best that can be used, althought it is somewhat expensive.

Internal bare walls of brick or stone merely pointed are far from satisfactory, and at least the lower portion (say to a height of 5 feet) should be rendered in Port and Cement neatly floated off.

This forms a much harder surface than plaster, and is consequently much more durable. Plaster is

not at all equal to withstanding the effects of water and steam.

Plaster is not by any means a good material for treating the ceiling or under side of roof, where there is constant vibration; a boarded ceiling is far preferable.

A cove formed between the floor and cement dado is to be recommend, so that there is no sharp angle to harbour dust and dirt.

Where the dado is of glazed brickwork special bricks can be had to serve the same purpose.

(3) **Floors.**

There are several kinds of dairy flooring material on the market, such as concrete, asphalt, red Dutch clinkers, flagstones, mountain limestone, etc. Wood floors are of no use whatever for the cheese-making dairy floor, but in some instances are used for the ripening room. It is, however, inadvisable to have a wood floor in the ripening room, as if any moisture escapes from the cheese the floor absorbs the liquid, which ferments and makes the wood smell objectionably. The best kind of flooring for the dairy is Granolithic Concrete, that is concrete formed with an aggregate of small granite cubes about the size of a pea. It is usually advisable to have such floors laid by specialists or at least by men who have had considerable experience in the mixing and laying of concrete.

Where the floor is of any extent, it should be laid in alternate bays; this largely overcomes the trouble often caused otherwise by the contraction in setting.

Stone floors are not at all suitable ; they are usually very porous and never wear evenly.

Staffordshire bricks laid on edge in cement on concrete form a very good floor.

Gutters in the floor should be not less than 9 inches wide and 2 inches deep at the high end. A fall of 1 inch to every 6 feet will usually be found sufficient.

Very often a gutter is arranged along the internal side of an outer wall.

It would appear to be far better if this gutter were arranged on the opposite side of the wall, *i e*, immediately in front of the outer face of the wall. Of course this can only be accomplished on the ground floor.

There must be no closed drains in the dairy, and a " cut off " should be fixed against each outlet. All drains leading away from the dairy must be trapped just outside the building.

(4) Light.

There should be large windows on each side of the dairy, as plenty of light is necessary in order to see that everything is clean. In hot weather too much sunlight can be excluded by drawing down the blinds, which should be fitted to the windows.

(5) Ventilation.

It is necessary to have the building well ventilated. Ventilation can be best arranged for by windows in opposite walls, the lower portions of these windows being made to open as hoppers to afford inlet ventilation, and the upper sashes made to swing on central pivots, so that the building can be well flushed with

fresh air. A Louvred ventilator on the roof is often an additional advantage, though in certain situations it may sometimes be provocative of down draughts.

The window frames inside should be covered with fine wire gauze, or finely perforated sheet metal. This will prevent the entrance of flies when the windows are left open during hot weather.

(6) The Roof.

The most effective roof for the dairy is one of thick thatch, but the objections to it are that it frequently harbours all kinds of dirt and vermin. Galvanised iron and thin slates are quite unsuitable for a dairy roof, as they make the building very hot in summer and cold in winter. A very good roof for a dairy is one insulated with slag wool or a good insulating felt. The roof should be counter-lathed so that there is an air space between the upper side of felt and the underside of slates. A tiled roof, where possible, should be sheated.

(7) Verandah.

It is advisable to have a verandah round the dairy to assist in keeping it cool in hot weather. The roof of the verandah may be made a continuous slope with that of the dairy; but better results are secured when a separate roof is built jutting out from the wall. In the absence of a verandah the eaves of roof should overhang some 12 inches; this will form some considerable protection to the walls from damp in winter and heat in summer.

(8) Heating Apparatus.

As cheesemaking is chiefly a summer occupation, it is not usually considered necessary to heat the dairy by artificial means. It is always, however, a great advantage to have means of regulating the temperature, and it is essential to heat the making and ripening rooms where cheese is made throughout the winter. The ripening room seldom requires to be artificially heated except in cases where it is advisable to ripen cheese quickly in cold weather, or when damp, muggy weather prevails. Heating the dairy artificially is best done by means of steam or hot water pipes and radiators, so that the fire generating the heat is not in the dairy. Open fireplaces and stoves in the dairy cause the room to be dusty, sometimes smoky, and dry the air too much.

(9) Underground Ripening Room.

The ripening room may be built on a level with the making room, or partly underground. It is best, when possible, to have the cheese ripening room about three-quarters underground. In this case it is necessary to have the walls and floors treated with mineral rock asphalte, covered by a 4½ inch inner lining of brickwork. Unless the dairy is built in an elevated position it may be a difficult matter to drain an underground room. Although underground ripening rooms are expensive to build, they are of great value in ripening cheese successfully, especially during hot weather.

(10) **Dairy Sewage.**

This consists of the washings from the appliances and utensils, and sometimes whey also. At small dairies, especially where pigs are kept to consume the whey, it is not an important matter, but in large dairies, especially when a lot of whey has to go down the drain it is a most difficult problem. Dairy sewage contains a fairly high percentage of organic nitrogen and carbon. In accordance with the Rivers Pollution Act of 1876 the running of this class of sewage into rivers or town systems of drainage is prohibited. Some of the methods adopted for dealing with dairy sewage are (1) The sewage is run into a cesspool away from the dairy and utilised as a manure. In surface irrigation the sewage is simply run on the land some considerable distance from the dairy. In many cases the soil soon becomes sick and the sewage then proves a nuisance

When the subsoil is of a gravelly nature the liquid is led away through an ordinary drain pipe at the end of which a number of smaller sized pipes branch out in all directions. These pipes are laid about a foot below the surface of the soil. This type of drain works very well in some porous subsoils.

(11) **Bacterial Treatment.**

Treatment by rapid bacterial fermentation may be adopted. It is an expensive system, and requires a considerable amount of attention to keep it in order. Described briefly, the system is as follows: Dairy sewage contains, in addition to the washings from

utensils, dirt and mud, etc., from the floors, and is of an acid nature, especially in hot weather and when it contains whey. The effluent is run through a neutralising chamber where it receives the necessary proportion of lime or some other suitable alkali in order to neutralise the acidity, so that the germs which bring about septic action can work in the effluent, and from this chamber enters a sludge, or settling tank. The mud, etc., settles to the bottom of the sludge tank, and the effluent slowly falls into a septic tank, and is changed in nature by the septic organisms. On leaving the septic tank the effluent is of a different nature chemically, and of a different colour to the crude sewage entering this tank. From the septic tank the effluent flows slowly over specially prepared beds of bacterial growths which destroy the obnoxious matter still remaining in the effluent, which, on leaving the beds, is quite clear and free from smell.

CHAPTER II.

THE COMPOSITION OF MILK AND DISTRIBUTION OF CONSTITUENTS IN CHEESEMAKING

(12) *Composition of Milk.*

Milk is a whitish fluid which is secreted by the lacteal glands of female animals for the nourishment of their young. For dairying, cow's milk is employed, except in very rare instances. Milk consists of six different constituents which vary in proportion according to the kind of animal yielding the milk and the natural characteristics of each individual animal. It is very seldom, if ever, the case that the constituents of milk are present in exactly the same proportions in any two samples. As it is impossible to state a definite composition for milk, we give the average of a great number of samples of cow's milk:—

Water	87.55 per cent.		
Butterfat	3.60 „ „		
Casein	3.10 „ „	Solids non-fat 8.85	Total Solids 12.45
Albumen	0.40 „ „		
Milk sugar or lactose	4.60 „ „		
Ash or mineral salts	0.75 „ „		
Total ..	100.00 „ „		

The constituents of milk other than the water are termed the total solids, and in milk of the above

composition are present to the extent of 12.45 per cent.

(13) Water.

It will be observed that about 87½ per cent. of milk consists of water. This is pure water, and can only be separated from the milk by evaporation. Now, although the water of milk is of no great value as a food, it is necessary for the manufacture of dairy products. In the production of cheese, after the curd is formed, most of the water goes to form the by-product, whey.

(14) Butterfat.

The fat of milk is termed "butterfat," although it is used for other purposes than butter-making. The fat of milk is the most valuable constituent from a commercial point of view, and also the most variable one. The fat contents of milk vary to a considerable extent with the breed of cattle, and with individual animals of any one strain. Butterfat is of a complex nature, and consists of a number of fatty acids combined with glycerine. It exists in milk in the form of minute globules, the largest of which measures about $\frac{1}{2500}$ of an inch in diameter. The slightly yellow colour of milk is due to a colouring matter, "lactochrome," contained in the butterfat.

(15) Casein.

This is the essential cheese constituent of milk, and is coagulated by rennet to form the curd. Casein may also be coagulated by dilute acids, and

dissolved by strong acids, but is not coagulated by heat. This milk constituent has flesh-forming properties, which makes it valuable as a food.

(16) **Albumen.**

This exists in normal milk to the extent of about 0.4 per cent., but in colostrum is often as much as 15 per cent. It is coagulated by heat, but not by rennet or acids. The albumen being in solution in the milk, passes off and is lost in the whey during cheesemaking.

(17) **Milk Sugar.**

Lactose, or milk sugar, is the carbohydrate of milk, and being in complete solution, most of it is present in the whey, instead of being retained in the cheese. Milk sugar is decomposed by bacteria and converted into lactic acid, which is essential for the production of cheese. This makes milk sugar a valuable constituent in the cheesemaking dairy.

(18) **Ash, or Mineral Salts.**

This is the most constant constituent of milk, and rarely does it vary from 0.75 per cent except in colostrum, or the milk yielded just after calving, which may contain as much as 2 per cent. of ash. The mineral matter of milk contains lime salts, which are essential for the formation of good curd in cheesemaking. The ash of milk is partly in suspension and partly in solution, so that about half of the mineral matter is present in the whey.

(19) Distribution of Milk Constituents in Cheese-making.

The weight of cheese obtained from a definite quantity of milk depends upon several factors, the chief of which are: (1) The percentage of solids in the milk; the higher the milk solids the greater the cheese yield. (2) The percentage of fat; the higher the fat content of the milk the more water is retained in the cheese, thus increasing its weight. (3) The skill with which the cheese is made—that is, the amount of fat retained in the cheese which by unskillful handling gets lost in the whey. (4) The time when the cheese is weighed or sold. Throughout the season the average cheese yield may be taken as 1¼ lbs. of fresh or 1 lb. of ripened cheese from a gallon of milk of average quality.

From a number of American experiments with the constituents in milk and cheese, it has been found that they are distributed in cheese in about the following proportions:—

	Water.	Fat.	Casein.	Albumen.	Milk Sugar, and Ash.
Lost in Whey	83.64	.31	.75	.61	5.16
Recovered in Cheese	3.70	3.39	1.73	.95	.66
Milk employed	87.34	3.70	2.48	.66	5.32

In both the cheese and whey the percentages of milk sugar and ash would include lactic acid produced from part of the sugar.

CHAPTER III.

THE FERMENTS OF MILK.

(20) Bacteria in Milk.

Bacteria, which are also termed "germs," "microbes," or micro-organisms, are single-celled plants, only discernible under a powerful microscope, and are present in greater or smaller numbers in all milk under ordinary conditions. It is only where milk is drawn from the cow under special conditions that sterile milk can be obtained without first being treated to destroy any bacteria in it.

Under favourable conditions, which are those supplying the necessary food, moisture and warmth, germs can multiply at a very rapid rate. It has been estimated that it is possible under ideal conditions for a single germ to increase to 16 millions in 24 hours. Bacteria reproduce by "fission" (that is, each germ divides into two), and on this account are often termed "fission fungi."

Bacteria multiply more rapidly in warm milk than perhaps in any other liquid as milk contains all the food elements essential for the sustenance of germ life, and is in a readily assimilable form.

There are a great many different kinds of bacteria, which perform different functions, and thrive best

at different temperatures. The optimum temperature of many species of bacteria is about 70 to 90 deg. F. Bacteria cannot live in intense heat or cold, in chemically preserved substances or in strong sunlight. The germs of milk may be classed roughly under two headings, the beneficial and the injurious ones. A great many of the taints and other faults in cheese are due to the action of bacteria; whilst on the other hand some species of germs are specially cultivated for the beneficial functions they perform in the manufucture of cheese. In the manipulation of milk for cheese-making the chief point is to encourage the development of the useful kinds of bacteria, and to keep the milk as free as possible from the injurious species.

(21) Ferments of Milk.

Milk is subject to various changes, such as souring, putrefaction, sliminess, etc., which are the result of ferments acting upon the milk constituents and producing fresh substances.

Some of the ferments natural to milk are so valuable that good cheese could not be made and ripened in their absence. On the other hand, certain ferments, if allowed to predominate in the milk, render it unfit altogether for the production of cheese. There are two kinds of ferments in milk, organised and unorganised. The organised ferments consist of bacteria, moulds and yeasts, all of which vary greatly in their size, shape and form, but differ chiefly in the method of reproduction. Spores or "seeds" are formed by many species of bacteria

as well as by moulds and yeasts when the conditions for vegetative growth become unfavourable. These organised ferments act directly on a substance, as is illustrated in the fermentation of milk sugar, by which lactic acid is formed. Yeasts acting on cane sugar produce alcoholic fermentation, but milk sugar is chiefly subject to lactic acid fermentation.

(22) Enzymes.

An enzyme is a chemical or unorganised ferment. It is the product of an organised or living ferment, but can perform its functions when the living ferment from which it originated is removed.

Milk contains a natural enzyme, "galactase," which is of great assistance in the ripening of cheese. Although the ripening of cheese is brought about very largely by enzymes secreted by the bacteria in milk, it has been proved by experiments that cheese will ripen by the natural milk enzyme when the germs have been destroyed by chloroform.

Enzymes are not altogether inactive at low temperatures, but their activity is reduced to a minimum at very low temperatures. They will slowly ferment the substance in which they are present even if it is in cold storage.

A very high temperature will destroy enzymes, and that is one reason why milk which has been pasteurised to a very high temperature is not so suitable for cheesemaking.

Enzymes grow best in the dark; exposure to light suspends their action, and gradually destroys them. For this reason, rennet, which is an unorganised

ferment, must be kept in barrels or stone jars, and not in glass bottles.

Enzymes show no definite shape or form under the microscrope, and exist in milk or cheese in infinitesimally small quantities.

When milk is obtained from healthy cows, and under the best conditions, it will contain the right kinds of organised ferments and enzymes which are required for the manufacture of cheese.

CHAPTER IV.

THE CARE OF MILK FOR CHEESEMAKING.

(23) Milk for Cheesemaking.

The first essential point in the manufacture of prime quality cheese is to utilise only pure, clean, whole milk of good quality. It is imperative that the milk be obtained in a cleanly manner from healthy cows, free from disease or ailments of the udder. Milk gets contaminated with the injurious species of organisms when the milking is not conducted under clean conditions. The cows' udders and the milkers' hands must be cleaned before commencing to milk.

Milk when in the udder of a perfectly healthy cow is practically free from bacteria, organisms however enter the inside of the cow's teats after the milking. Occasionally germs may enter the lower parts of the milk cisterns of the cow's udder, but after the first few squirts of milk are drawn sterile milk is obtained, unless the udder is diseased.

If a pint of milk consisting of the first milk from each teat is saved, and a pint of milk towards the end of milking the same cow, and each sample is kept under similar conditions, if will be found that the milk first drawn turns bad much quicker than the last drawn.

The air of the cowshed is teeming with bacteria which readily enter the fresh warm milk as it is being drawn from the udder, whilst milk which is left standing in the byre soon becomes badly contaminated with various species of bacteria. The cowshed must be kept clean at all times, and limewashed at least twice a year, or more often if possible.

The cows should be kept as clean as possible under practical conditions. The dirtier the cows and the byre, the more obnoxious will be the species of bacteria in the air of the shed. It is only when milk is produced under clean conditions from healthy cows that the beneficial kinds of germs will predominate in the milk.

Warm milk has greater power to absorb odours and bacteria, therefore it should be removed from the byre as soon as each cow is milked.

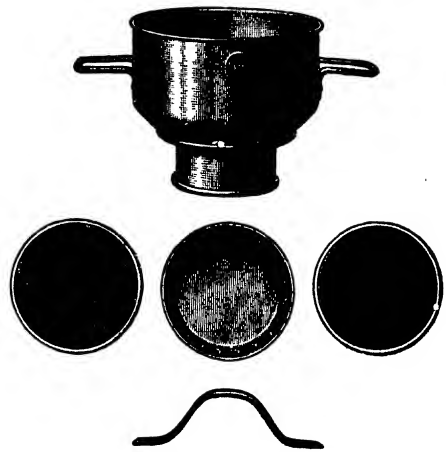
(24) Filtering the Milk.

The milk from each cow should be taken direct to the dairy and poured through a milk filter, which appliance is usually suspended over the cheese vat. Ordinary straining cloths are of no use for extracting the finer foreign matter from milk, and tainted cheese often results from using straining cloths or muslin.

The type of milk filter to employ is one having a sheet of sterilised cotton-wool fixed between two wire gauze discs of fine mesh. After use the filter is washed and the wool filtering medium burnt.

When the cowshed is some distance from the dairy the milk churn in which the milk is taken to the dairy should be left outside the byre, at a suitable distance

away to prevent the milk absorbing odours. A filter should be placed over the churn, so that all the milk is cleansed immediately after milking and before any dirt has time to dissolve in the warm milk. Even when milk is obtained under the best conditions it may occasionally contain some dust,



THE PURLAC MILK FILTER.

[In this filter a cotton-wool medium is used, held in position between two pieces of brass gauze, all kept in place by a spring clip, instantaneously dismantled for cleaning.]

scales, hairs, and other foreign matter which accidentally find their way into it. All this extraneous matter carries with it a large number of germs.

It is not possible for the farmer to obtain sterile milk under the ordinary practical conditions, but the lower the varied bacterial content of the milk,

the better will be the results in the cheese made therefrom. The species of bacteria essential for the production of good cheese can be added to the milk in the form of starter.

(25) Milking in the Fields.

In some districts it is the practice to milk the cows in the fields during the summer months, and from a bacteriological point of view, milk obtained under these conditions is comparatively clean. So far as bacteriological purity is concerned, however, the cleanliness of milk depends more upon the kind than the number of germs present.

The habitat of bacteria, especially those of the obnoxious species, is dirt and filth, and the decomposition of manure and urine is most favourable to their development. A dirty, ill-ventilated and badly-lighted cow byre is an obvious source of milk contamination.

(26) Cheese from Grass-fed Milk.

Every cheesemaker knows the best quality of cheese is produced when the cows are getting their food from good pastures that are free from weeds or plants which are likely to taint the milk. The cheesemaking season is from about the beginning of April to the end of September, but in many instances it is necessary to commence cheesemaking earlier and to continue it later than the above period. During the early spring and late autumn it is necessary to keep the cows in the byre during the night and feed them largely on artificial foods. The unnatural

feeding of cows always tends to increase the difficulties of the cheese-maker. Most foods give off odours peculiar to their kind, and these are readily absorbed by the milk at the time of milking. This source of trouble can be greatly reduced by feeding the cows *after* instead of before milking, especially with the foods that are likely to cause taints, and by not keeping the milk in the byre longer than is absolutely necessary.

(27) Cheesemaking in Different Districts.

Different kinds of cheese are made in different districts, after which they are generally named. A great many people are under the erroneous impression that it is quite impossible to make prime cheese of a certain kind outside a certain locality. It is undoubtedly a fact that the nature of the milk produced in different localities may vary slightly in nature. For example, milk from a limestone soil is naturally sweet, and possesses good keeping qualities, while that from heavy clay soils is in comparison inferior; but when once the principles of cheese-making are understood, prime cheese of any variety may be made in almost any district, provided that the milk is clean and of good quality. The chief point is to know and understand the nature of the milk, and alter the process of manufacture accordingly.

(28) Colostrum.

Colostrum, or beastings, is the name given to the milk yielded the first few days after a cow has

calved. It is darker in colour, and thicker than ordinary milk. Colostrum contains a lot of granular bodies, known as "colostrum corpuscles," which consist of the old cells of the inner lining of the udder cavities. The composition of colostrum varies considerably, but the following will give some idea of the proportion in which the milk constituents exist in colostrum :—

Water	.. ..	71.67	per cent.
Fat	.. ..	3.40	„ „
Casein	.. ..	4.80	„ „
Albumen	.. ..	15.85	„ „
Sugar	.. ..	2.50	„ „
Ash	.. ..	1.78	„ „
		100.00	

The fat in colostrum is slightly different in composition from that present in ordinary milk, as is indicated by its having an higher melting point. The sugar is subject to fermentations which milk sugar is not. There is also a difference in the composition of the mineral salts as compared with those found in ordinary milk. The high percentage of albumen alone renders colostrom objectionable for cheesemaking. In normal milk there is only about .4 per cent. of albumen, and most of this passes off in the whey.

As the length of time since calving increases, the colostrum corpuscles gradually disappear and the composition changes, until it becomes that of normal milk. Colostrum is of a highly putrefactive character, and on no account must the milk of a newly calved cow be used for cheese-making until it has passed the colostrum stage. Always allow

at least five days to elapse after calving, and then test the milk by heating it. Ordinary milk will boil, but colostrum, on account of the high percentage of albumen it contains will coagulate on being heated to above 170 degrees F. Do not use the milk for cheese-making until it will boil with nothing more than the ordinary thin scum forming on the surface, and shows no signs of coagulating. The presence of a small percentage of colostrum is sufficient to spoil a whole vat full of milk made into cheese.

(29) **Milk from Diseased Cows.**

Other milk which must not be used for cheese-making is that obtained from cows in ill-health, or having any disease of the udder. When cows are ill, or in œstrum, the milk is of an abnormal nature, and does not produce good curd, the result generally being the production of ill-flavoured, bad-keeping cheese. The milk in a diseased udder of a cow may be contaminated very badly with obnoxious organisms, which render the manufacture of prime quality cheese an impossibility. When milk is badly contaminated in this way the normal ripening of the milk and curd is interfered with, and the cheese putrefies, in patches or throughout. Cows with diseased udders should be milked last, and their milk kept apart from that for cheese. It may after being well boiled be fed to pigs.

(30) **Milk from Different Breeds of Cows.**

Milk from all breeds of cows may be successfully converted into cheese, but that yielded by Ayrshire

cows is generally considered the most suitable for cheesemaking. The milk obtained from this strain of dairy cow is of good quality, whilst the fat globules are very small, uniform in size, and evenly distributed throughout the milk. This causes the cream to take a long time to rise, which is an advantage in cheesemaking. When the fat globules are small and well distributed it is of great assistance in retaining all the fat in the curd and the finished cheese.

Milk from Shorthorn cows is perhaps most extensively employed for cheesemaking, as this breed yields a large quantity of milk of good average quality. The Shorthorn cow thrives in any part of the country, and is an excellent cow for general purposes, the milk being suitable for milk-selling, cheese-making, or butter-making. At many farms where Shorthorns are kept, the milk is sold in the winter, and made into cheese during the summer. When the milking days of this breed of cow are over, the animal, provided it is not too old, can soon be got ready for the butcher.

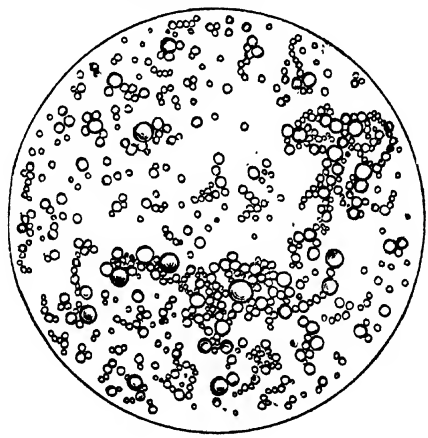
Jersey cows yield the richest milk of any breed. The Jersey cow does not, generally speaking, give a very big quantity of milk, but it contains a high percentage of fat, which exists in the form of large globules, which soon rise to the surface when the milk is allowed to stand for a short time. This breed of cow is an excellent one on the butter-making farm, where butterfat is the chief constituent of the milk required.

CHAPTER V.

THE QUALITY OF MILK FOR CHEESEMAKING.

(31) Quality of Milk for Cheese.

The best milk for cheese-making is that containing a high percentage of fat, the globules of which are present in a fine state of division. With a high per-



MICROSCOPICAL APPEARANCE OF THE FAT GLOBULES IN MILK.
Note the varying sizes and clusters of the globules.

centage of fat there is usually a high percentage of casein also, and the richer the milk in these

constituents, the greater the quantity of cheese that can be obtained from it. The disadvantage of milk containing large fat globules is that it is much more difficult to keep the fat in the cheese than when the globules are small. The more fat there is present in a cheese, the more moisture there is also, and these constituents make the finished product " mellow " when ripe.

(32). Variations in the Constituents of Milk.

There are many factors influencing the quality of milk, the chief variation being found in the fat, which may vary from 2.5 up to 5 or 5.5 per cent. The chief factors influencing the quality of milk are :

1. *Breed of Cow.*—There are some breeds which are more suitable for the production of beef than milk, and it is not advisable to keep such where the milk is produced expressly for cheese-making. Some breeds, such as the Channel Island cattle, are noted as butter producers, others are best for milk-selling, as they yield a much larger quantity of milk, though it may not be particularly rich in fat. Where milk is sold at so much per gallon it is not a good commercial proposition to sell rich milk containing 5 per cent. of fat, when at the same cost per gallon a much larger quantity of milk containing about 3.5 per cent. of fat can be obtained. To give some idea as to the quality of milk yielded by different breeds of cows, Jersey milk contains on the average 4.5 to 5 per cent. of fat. Shorthorns yield a much larger quantity of milk, the average quality of which may be taken as 3.7 per cent., and is best suited for

general purposes. Ayrshires, which are noted for giving milk most suited for cheese-making, yield a good quantity of milk having present in it on the average 3.8 per cent. of fat. There are various other breeds of cows yielding milk of varying quantity and quality, but the above stated three breeds are those generally considered best for butter-making, general purposes, and cheese-making respectively.

2. *Age.*—The age of the cow has some effect upon the quality of the milk produced. The formation of milk depends upon the activity of the milk glands, so that when a cow is at its zenith of health and strength, then the best quality of milk is produced. As a rule, during the first two periods of lactation a cow yields poorer milk than subsequently. Generally a cow is at its best between four and eight years of age, but this depends entirely upon the natural characteristics of the individual animal and the treatment she has received. Individuality is most marked in every herd, whether the herd consists of one breed entirely or of mixed breeds. Even when all the animals in the herd are fed and cared for in the same way, there is a vast variation in the quality of milk yielded from individual animals of the same age, breed, and at the same stage of lactation period.

3. *Lactation Period.*—Starting by producing colostrum, a cow will yield the thinnest or poorest milk shortly after calving. The milk then resumes its normal quality, and gradually, as the supply becomes smaller, the solids increase in proportion, and we get much richer milk till the cow dries off. The largest

quantity of milk is yielded at four to six weeks after calving. As the fat content of the milk increases the fat globules usually diminish in size.

4. *State of Health.*—The best quality milk is yielded when a cow is in a good state of health. When a cow is in ill-health the quality of the milk decreases, the fat being the constituent most affected.

5. *Feeding.*—There is a great diversity of opinion as to what effect feeding has on the composition of milk. Milk is formed by the building up and breaking down of cells in the cow's udder. The quantity of milk produced depends upon the capacity of the cow for producing these cells, and the quality of the milk depends very largely upon the natural characteristics of each animal. It has been proved in several experiments that if a cow is given a proper ration containing the essentials for milk-production as well as its bodily wants, then if extra rich food is given it may increase the solids of the milk for a time only, then the quality falls back to normal. When cows are under-fed, or not supplied with suitable food, then an increase or alteration of the food would have a beneficial effect upon the quality of the milk. Certain foods tend to "force" or increase the quantity of milk for a time, but at the expense of quality.

6. *Time of Milking.*—Except in rare instances, there is a difference in the quality of the morning's and evening's milk, the latter being generally the richer. Sometimes the difference in the fat content is only very slight, and at other times it is as much as

1 per cent. The longer the period between milkings, the greater is the variation in the quality of the milk at each meal. Most kinds of cheese are made from mixed morning and evening milk, hence the quality is normal. Where milkselling and cheesemaking, however, are carried on together it is better to use the evening's milk for cheese, so long as the morning's milk is not below the legal standard of quality. The evening's milk being rather richer yields a greater quantity of cheese.

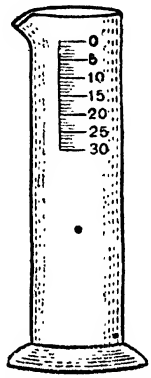
(33) Strippings.

The first milk drawn from the cow is very poor and watery in character, but the last milk, or strippings, is exceedingly rich, and may contain as much as 8 to 10 per cent. of fat. It is, therefore of great importance to thoroughly strip the cows at each milking, so as to obtain all the richest portions. If the first two or three squirts of milk from each teat are discarded, the quality of the milk is improved, and from a bacteriological point of view is cleaner and better for cheese. Cows which are not properly "stripped" at each milking soon fal off both in the quantity and quality of their yield, and in consequence the output of cheese is lessened.

(34) Milk Records.

In order to obtain a maximum quantity of milk of good quality at the lowest possible cost for cheesemaking, it is advisable to keep milk records. The quantity and quality of milk yielded by each cow can then be ascertained. Cows that are utilising the food chiefly for putting on flesh, or those not giving a sufficient quantity of good milk can be weeded out

of the herd. The lower the cost of milk production the greater will be the profit made on the cheese.



THE CREAMOMETER.

Showing the graduation marks on which the percentage of cream present in the milk can be read off after it has stood for 24 hours.

(35) Tainted Milk.

The taints in milk come under two main headings :—

1. Physical taints, which are absorbed by the milk, such as food flavours and odours. When milk is contaminated in this way the taint will not increase if the milk is removed from the source of contamination, and kept in a pure atmosphere for a time.

2. Bacterial taints, which are the result of obnoxious bacteria entering the milk from various sources. If bacterially contaminated milk is kept warm for a time in a pure atmosphere free from

contaminating influences, the taint in the milk will be found to increase, due to the germs multiplying rapidly.

(36) **Chief Causes of Milk becoming Tainted.**

1. Cows suffering from udder trouble and other diseases, and when at periods of "œstrum." Also the admixture of milk from a newly-calved cow before it has passed the colostrum stage.

2. Cows, and the byre kept in a dirty state, and udders not cleaned before milking. Cows wading in ponds of stagnant water. The dirty water, and mud stirred up, becomes dried on the cows' flanks and udders. Such matter contains the species of germs that taint milk. The germs enter the milk pail from the cow's body at the time of milking, as it is disturbed by the head and hands of the milker.

3. The air of the byre, instead of being as pure as possible, being contaminated with dust, and odours from food, etc.

4. Dirty milking, which causes particles of manure and hairs, etc., to find their way into the milk. Contaminated water for washing the milk pails.

5. Failure to remove the warm milk from the byre, where it readily absorbs bacteria and odours.

6. Allowing the milk to cool itself during the night in a dirty or badly ventilated dairy. The employment of unclean utensils in the dairy. It will be observed that the chief cause of tainted milk is lack of general cleanliness in the production and treatment of the milk.

CHAPTER VI.

RAPID METHODS OF MILK ANALYSIS.

The quality of milk is generally estimated by the percentage of fat it contains, and when the fat content is high, the other milk solids are generally high in proportion also. It is a great advantage to test milk in order to ascertain the quality of that yielded by each individual cow. In the case of purchasing milk for cheese-making, it is advisable to know the quality of the milk obtained from each source of supply.

The Gerber Test.

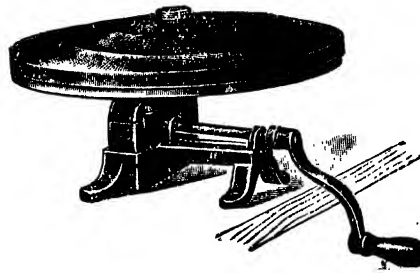
To determine the percentage of fat in milk, the Gerber test is the one most commonly employed, as it can be easily and quickly carried out. Gerber testers can be procured in various sizes, and consist of the following apparatus :—

1. Two or more (according to the size of the apparatus) Gerber test tubes, and a wooden rack in which to stand them. These tubes consist of small bottles having long graduated necks.

2. Three pipettes for measuring the ingredients used for the test. Instead of pipettes, special automatic measuring apparatus may be employed.

3. A centrifugalising machine in which to revolve the test tubes.

4. Chemicals, consisting of sulphuric acid, having a specific gravity of 1.820 to 1.825, and amyl alcohol,



THE GERBER BUTYROMETER, OR MILK TESTER.
The simple centrifugal instrument used so largely for milk testing. (Dairy Supply Co.).

the specific gravity of which is .816. It is most imperative that these chemicals are of the correct strength. It is perhaps advisable to procure fresh supplies of chemicals from the firm supplying the testing apparatus.

(37) Making the Test.

First invert the test bottles in the stand, then carefully measure 10 c.c. (cubic centimetres) of sulphuric acid into each test tube, being careful not to wet the neck of the tube with the acid, or the stoppers will not hold securely. Next measure 11 c.c. of milk

from the sample which has just been thoroughly mixed. If the sample bottle is only half full it may be shaken gently to mix the milk, but if the bottle of milk is too full for this, pour the milk from one vessel to another several times. It is advisable to allow the milk to run very slowly down the side of the tube, so that it does not come into too violent and quick contact with the acid. Unless the milk is carefully added it gets charred and produces a discoloration of the fat, and the charred matter often obstructs the reading. Now add one c.c. of amyl alcohol, and fix the rubber stoppers securely in the necks of the test tubes. Shake the tubes well and turn them upside down once or twice to dissolve all the curdy matter in the milk, and allow the acid to run out of the neck, then put the test tubes in the centrifugal machine. The dissolving of the casein by the acid is very rapid, and causes the contents of the tubes to rise greatly in temperature. Be careful not to put the tubes in the machine until all the curdy matter of the milk is dissolved.

(38) **Centrifugalising.**

Place the tubes in the rotary or centrifugal machine with their graduated necks towards the centre, and revolve the machine rapidly for three minutes, then stop it gently, take out the tubes, and read off the fat column before it has time to get cold. When the test is made in a satisfactory manner the fat will appear as a pale straw-coloured liquid in the graduated neck of the test tube.

(39) Reading the Test.

To read the column of fat get the bottom of it level with one of the long graduation marks. This is done by working the stopper either in or out of the tube. Read from the bottom of the fat column up to the bottom of the meniscus, or curved surface

THE "GERBER" TEST BOTTLE, for ascertaining the percentage of fat in milk.

at the top of the column. The space between the long marks represents 1 per cent., and between the small marks .1 per cent. If the fat occupies three large divisions and seven small ones, the milk contains 3.7 per cent. of fat. Half a small division

represents .05 per cent., so that three large and seven and a half small divisions would show the presence of 3.75 per cent. of fat.

(40) Care of the Apparatus.

On completion of the test the tubes should be emptied into a vessel which is not attacked by the acid, or on to the earth or gravel outside the dairy. Wash out the test tubes, first with warm water, then hot, and leave them inverted in the rack to dry. The rubber stoppers should be soaked in water that has been made alkaline by the addition of soda, in order to neutralise the acid on the rubber, and so preserve them. Next wash the stoppers in clean water, and allow them to dry naturally. Sunshine or artificial heat causes the rubber to crack, and soon become unfit for use. It is advisable to keep some ammonia handy, in order to neutralise the acid, and prevent burning, should any get spilled on the tester's hands or clothes.

(41) Testing Whey.

In the manufacture of cheese a small percentage, about .3 per cent., of fat escapes in the whey. When cheese is badly made the whey is richer in fat, and the cheese consequently poorer in quality. It is therefore advisable to test the whey occasionally. The whey is tested in the same manner as the milk, with the exception that it is centrifugalised three separate times instead of once only. Between every two rotations the bottles are taken from the machine

and immersed in water at 175 deg. F. for a minute or so, to maintain the temperature of the contents of the test tubes.

(42) Special Test Tubes.

As there is only such a small percentage of fat normally present in whey, special test tubes having a narrow bore neck are used. In these tubes 1 per cent. of fat occupies a considerable length of the tube, hence the subdivisions are large and easily read.

(43) Testing for Milk Solids.

For butter-making fat is about the only constituent required, the other milk constituents existing in butter to only a very small extent. For the manufacture of cheese other solids, in addition to the fat, are required, therefore a test for milk solids is advantageous to the cheesemaker.

The method of estimating the percentage of solids in milk in the most simple way is by means of an instrument known as the lactometer used in conjunction with the Gerber test for fat. The lactometer registers the specific gravity of milk, but this test alone is of no value for determining the quality of the sample tested, as will subsequently be shown.

(44) Specific Gravity.

The specific gravity of a liquid is the weight of a given volume of that liquid compared with the weight of an equal volume of pure water, both at a

temperature of 60 deg. Fahr., and may be expressed by the following formula :—

$$\text{Specific Gravity} = \frac{\text{Weight of a definite volume of milk}}{\text{Weight of an equal volume of pure water}} \text{ (Both at 60 degs. F.)}$$

Example :—
Volume of Milk 103.2 lbs. at 60 deg. F.
Equal volume of water 100 lbs, at 60 degs. F. $= \frac{103.2}{100} = 1.032$ Specific Gravity

The fatty portion of milk is lighter than the water, and the non-fatty solids, which exist in milk in a much greater proportion than the fat, are heavier than water. This makes milk heavier than water, giving the former a higher specific gravity. The weight of a definite volume of liquid will vary according to its temperature, and in testing milk for specific gravity it must be at the same temperature as that of the water used for comparison. It has been found that a temperature of 60 deg. Fahr. is most suitable for all practical purposes. The specific gravity of milk varies from 1.028 to 1.034, but on the average may be taken as 1.032.

(45) The Lactometer.

This instrument is used to find the specific gravity of milk without weighing equal volumes of milk and water, and then comparing the weights. The lactometer consists of a glass bulb having a long graduated neck or stem. The bulb is weighted with shot or quicksilver, so that when the instrument is immersed in water or milk the stem remains in an upright position. The stem is graduated from 0 at the top down to 40, in order to register the

specific gravities from 1 to 1.040. The weighting is so regulated that when the lactometer is placed in pure water at 60 deg. F., the 0 on the scale is just level with the surface of the water, and represents a specific gravity of 1. When placed in a liquid lighter than water the lactometer will sink below the

THE LACTOMETER.
For ascertaining the Specific Gravity of Milk.

graduation mark 0. If placed in genuine milk, which is more dense than water, the lactometer would sink until the surface of the milk is in contact with the figures somewhere between 28 and 34 on the graduated stem, which represents a specific gravity of 1.028 to 1.032

(46) Using the Lactometer.

When using the lactometer the milk should first be thoroughly mixed, then poured into a trial jar supplied with the lactometer. Place the lactometer in the milk and allow it to float naturally without touching the sides or bottom of the jar. Remove any froth or bubbles on the surface of the milk, and when the lactometer has settled the reading will give the specific gravity of the milk if it is at a temperature of 60 deg. F. The best way to obtain a correct reading is to get the eyes at the same level as the surface of the milk. Freshly drawn milk contains a lot of air bubbles, and should be allowed to stand some time before being tested.

(47) How to Correct the Temperature.

Although the specific gravity of milk is taken at 60 deg. F., it is not absolutely necessary to regulate the milk to that temperature. Before putting the lactometer into the milk, its temperature must be carefully noted, and if other than 60 deg. F. corrections in the reading can be made accordingly. To correct for temperature *add* .1 to the lactometer reading, or .0001 to the specific gravity for every degree above 60 deg. F., and *substract* .1 or .0001 for every degree below 60 deg F.

Example:—If the lactometer reads 31.5—i.e., 1.0315—at 65 deg. F., corrected to 60 deg. F. it would be 32, or 1.032. A very useful form of lactometer, called a thermo-lactometer, contains a thermometer in the lower part of the lactometer. By

the use of this instrument both the temperature and the specific gravity of the milk can be ascertained using only the one instrument.

(48) Why the Lactometer alone is not Reliable.

The fat is the lightest constituent of milk, and if some fat has been extracted the milk will be more dense, showing a higher specific gravity. Water is lighter than milk, therefore the addition of water would make milk lighter and lower in specific gravity. The unreliability of the lactometer lies in the fact that after extracting fat from milk and making it heavier, the judicious application of water to the milk will render the specific gravity normal. When used in conjunction with the Gerber test the lactometer is of great assistance in determining the percentage of solids in a sample of milk.

(49) How to Estimate the Milk Solids.

When the percentage of fat in milk and its specific gravity are known, sufficient data are obtained to calculate to a nicety the percentage of milk solids. It has been found that such calculated results are only just slightly inferior in accuracy to gravimetric analysis. A very simple formula, which we have used for many years with satisfactory results, is :—

$$\text{Per cent. solids non-fat} = \frac{\text{Lactometer reading at 60 deg.} + \text{per cent. fat.}}{4}$$

In this calculation it is imperative that the lactometer reading be very carefully taken, and corrected

for temperature if necessary. The milk must have also been accurately tested for fat.

Example :—If a sample of milk containing 3.5 per cent. of fat registers a lactometer reading of 31.5 at 65 deg. F., the solids non-fats are found thus :—31.5 + .5 = 32, the lactometer reading corrected to 60 deg. F. $\frac{32 + 3.5}{4}$ = 8.88 per cent. solids non-fat. The addition of the fat gives 12.38, the total solids of milk. This formula is based upon the assumption that :

(1) The Lactometer reading of pure water is 0°.
(2) Each 1% of solids non-fat raises the reading by 4°.
(3) Each 1% of fat lowers the reading by 1°.

There are other formulæ, but the one given is sufficiently reliable for all general purposes.

There are sliding scales and tables procurable for those who do not care to work out the calculations. One of the best and most commonly used scales is the sliding scale devised by Droop Richmond.

CHAPTER VII.

RAPID TESTS FOR ASCERTAINING THE PURITY OF MILK.

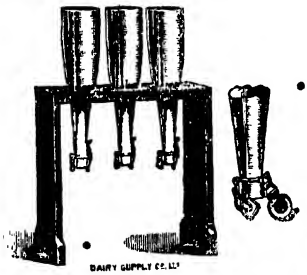
As already stated, it is absolutely necessary to use only pure clean milk for successful cheese-making. Where milk is made into cheese on the farm, precautions are generally taken to have it produced under the best conditions. At cheese factories all the milk is purchased from different sources, from some of which milk in a doubtful state of cleanliness is obtained.

At some cheesemaking farms also many small quantities of milk are procured from surrounding farms and mixed with that produced on the farm, for conversion into cheese. In such cases it should be delivered twice daily. In cases where milk is purchased from different sources, tainted produce is much more prevalent than where full control of the milk is obtained. Unclean milk is a very prolific source of tainted cheese, and therefore when milk is obtained from various sources it should be tested periodically.

(50) The Gerber Test for Dirt.

This test is a very simple one for ascertaining the amount of dirt or sediment in milk. All the dirt in a certain quantity of milk gets collected on a small

white cottonwool pad. The apparatus required consists of a glass bottle open at both ends, a stand, and some small cottonwool discs. The narrow end of the bottle is fitted with a cap containing a small piece of wire gauze, on which is placed the cottonwool disc. The bottle is then placed narrow end downwards on the stand, and a quantity of milk—usually a pint—is poured in the wide end of the bottle and



DIRT TESTER PADS.

Showing results from Dr. Gerber's Tester.

Dirty Milk. Clean Milk.

DIRT TESTER (Dr. Gerber.)

leaves it through the collecting disc at the bottom end. A receptacle is placed under the tester to receive the tested milk. It is best to warm the milk to about 100 deg. F., as warm milk, being less viscous than cold, more easily passes through the fine filtering medium. Milk has its maximum viscosity at a temperature of 32 to 50 deg. F.; as the temperature rises the viscosity of the milk decreases. When milk is very dirty indeed, the filtering medium sometimes gets clogged up, preventing all the milk going through. The cottonwool disc is carefully removed and placed on a piece of white blotting-paper, which readily absorbs the

moisture from the wool. The amount and nature of the sediment collected will give an idea as to the cleanliness of the milk. If the wool is in a dirty state, it should be sent to the supplier of the milk with instructions to observe much more care in handling the milk.

(51) Fermentation Tests.

When milk is bacterially tainted, the taint will increase, and a small quantity of such milk easily contaminates a large volume of sound milk if mixed with it. As bacterially contaminated milk cannot be recognised with the naked eye, the fermentation tests may be resorted to in order to detect milk which is being delivered in an unsatisfactory state. It may happen that bacterially contaminated milk is due to a cow having a diseased udder, and in that case if the milk from each animal is tested, the one giving the tainted milk may be discovered.

(52) The Ordinary Fermentation Test.

To carry out this test, take a number of large test tubes, or other similar glass vessels, each of which is provided with a cover, preferably a tin cap. Before use, these vessels must be thoroughly cleansed, then sterilised by boiling, or baking. Allow the tubes to cool, then fill nearly full, using a separate tube for the milk of each supplier or that from each cow. Immerse the tubes in a water bath, or other suitable vessel, up to just above the level of the milk in the vessels. Maintain the water at a temperature of 105 deg. F. until the test is completed. A spirit

lamp, or night light, should be placed under the vessel containing the water as a means of keeping the water at a uniform temperature. In seven or eight hours' time take each tube, shake it well, and see if any gas is given off. Next notice the appearance, taste and odour of each sample. Replace the tubes in the warm water, and leave them for another four or five hours (twelve hours in all), then examine the milk in each tube.

(53) Results of the Test.

The conclusions from observations made in this way by Dr. Gerber, after having summarised some thousands of tests, are:—(1) Sound milk will coagulate normally in twelve hours when treated in the above-described manner. (2) Good milk which has been properly handled should not coagulate in less than twelve hours, or show any abnormal conditions when coagulated. (3) If milk has not coagulated in twelve hours, it shows abnormal milk with the presence of undesirable fermentations. (4) Milk from sick cows, or those with diseased udders, will coagulate in less than twelve hours, so will milk that is badly contaminated bacterially. (5) Milk which does not show abnormal coagulation but gives off an unpleasant smell, should be considered unclean milk. In making this test the condition of the curd must be carefully noted. Sound milk gives a curd of a solid, compact nature, free from any gas bubbles and unpleasant smells. If the curd is at all abnormal in formation or odour, the milk should be regarded as tainted.

(54) The Wisconsin Curd Test.

In carrying out this test curd is formed in half an hour or less, and the state of the curd upon examination forms an idea as to the cleanliness, or otherwise of the milk. To make this test, take some wide-mouthed glass jars which are fitted with tin caps. Sweet bottles answer the purpose well if others are not available. The bottles must be cleaned and sterilised by boiling them for a few minutes. Put a pint of milk from each sample to be tested in separate bottles, and place them in a tub or other vessel containing hot water. Regulate the temperature of the samples to 98 deg. F., and after testing for temperature, wash the thermometer, as otherwise it may be the means of a bad sample contaminating the next one in which the thermometer is immersed. To each jar of milk add 10 drops of rennet extract, and shake the jars in a rotary fashion in order to mix the milk and rennet together.

When a fairly firm curd is formed, cut it into small pieces with a knife which is washed after the cutting of the curd in each different sample, and as the whey separates keep pouring it out of the bottles. Keep the curd in the jars for another six to twelve hours, during which time the temperature of 98 deg. F. must be obtained, as this is favourable to the development of bacteria. The pieces of curd are then examined.

(55) Results of the Test.

Impurities and objectionable bacteria in the milk will cause gas to accumulate, and the curd to contain

a lot of small holes the size of pinheads. The holes produced in curd by bacteria are round or oval, with glazed interiors, and differ from holes mechanically produced as the result of all the particles of curd failing to mat together. If the curd is badly blown with gas, so that it presents a somewhat honeycombed appearance, it denotes that the milk is very badly contaminated with organisms which are partial to filth. If such milk was made into cheese, small pieces of curd would probably float to the surface after being cut.

A sound curd free from gas holes and having a clean odour indicates clean milk which has been produced in a cleanly manner. If the curd has a good appearance, but a putrefactive odour, the milk should be regarded as bad. There are several species of bacteria which produce gas in milk, curd, and cheese, but the chief one responsible for this trouble is a type of germ known as bacillus coli communis. This species of microbe is present in the intestines of all animals, and the dirtier the conditions under which milk is produced, the greater the number of these bacteria will it contain.

CHAPTER VIII.

THE SOURING OF MILK AND TESTING FOR ACIDITY.

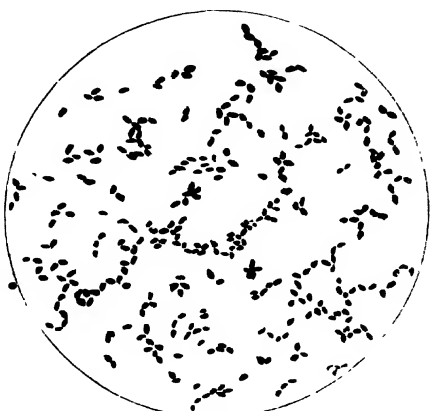
(56) The Souring of Milk.

Most of the changes occurring in milk, the chief of which is souring, are due either directly or indirectly to the action of bacteria. When milk is freshly drawn from the cow, it is nearly neutral, but gives an amphoteric reaction—that is, it will turn red litmus paper blue, and blue litmus paper red, but the acid usually predominates slightly. In a short time the milk becomes acid, due to the action of bacteria. Unless the milk is cooled to check the development of these organisms, it assumes an acid flavour, and ultimately coagulates. This is the result of the lactose, or milk sugar, decomposing under the action of bacteria, and being converted into lactic acid.

The lactic-acid-producing bacteria convert one molecule of lactose into four molecules of lactic acid, and this change is expressed in the following manner :

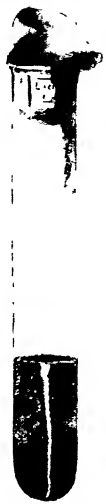
$$\underset{\text{Milk sugar.}}{C_{12}H_{22}O_{11}} + H_2O + \text{bacteria} = \underset{\text{Lactic Acid.}}{4C_3H_6O_3} + \text{bacteria.}$$

There are a number of species of bacteria which generate acids in milk, but the chief kind that produces pure lactic acid is known as Bacillus acidi



A Pure Culture of the Bacillus Acidi Lactici

The ordinary milk souring organism as seen stained and highly magnified by a microscope.



A Streak Culture of Bacillus Acidi Lactici

The culture is grown in the bacteriological laboratory on nutrient gelatine and then transferred to milk.

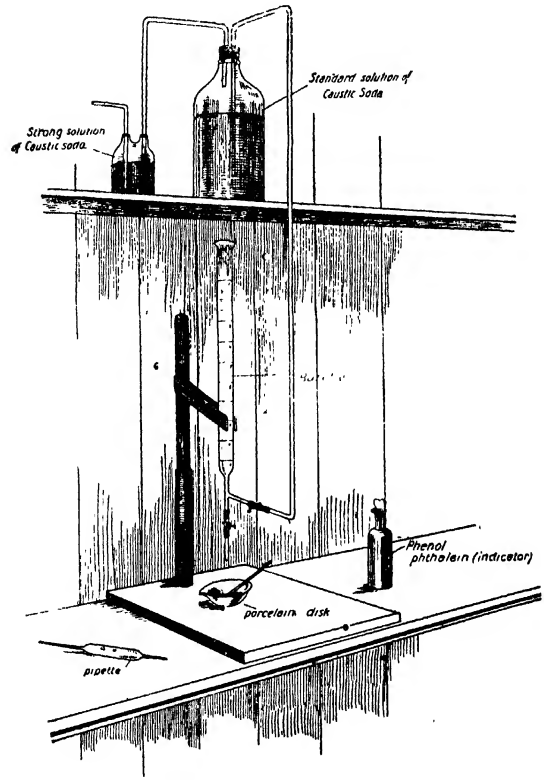
A Stab Culture of Bacillus Acidi Lactici.

lactici. The acid-producing organisms cannot go on acidifying the milk until all the milk sugar has been decomposed; for soon after the milk has coagulated the amount of acid present acts as a poison or deterrent to the bacteria producing it. Other species of bacteria then take charge of the milk, and generally cause it to putrify.

The production and control of lactic acid is of great importance in the manufacture of cheese, and it is absolutely necessary for the cheesemaker to know definitely the exact degree of acidity present in the milk, whey and curd at the various stages of the process of manufacture. A rough idea as to the amount of acidity present can be obtained by noting the taste, smell and appearance of the milk, whey, or curd, but for producing cheese of uniform quality from time to time, some definite means of accurately determining the acidity of the milk and whey is most essential. For this purpose a dairy acidimeter is most commonly used

(57) The Acidimeter.

The general principle of the method of testing milk for acidity with this appliance is as follows: A few drops of an indicator called phenol pthalien, which is colourless when in acid, is added to the liquid, the acidity of which is to be found. So long as the liquid remains in an acid state, the phenol pthalien remains colourless, but the moment the liquid is alkaline the colour changes to pink, and this change of colour serves as an accurate indication of the instant when the acid has been neutralised. The strength of the



ACIDIMETER, as used in a cheesemaking dairy, where it is constantly required. A simple form of the above only is necessary in small dairies.

acidity is measured by finding how many cubic centimetres of an alkali of a certain definite strength are necessary before the colour turns pink. The more alkali required to produce a pink colour in the liquid tested the greater will be the percentage of acidity therein, and vice versa.

(58) **The Apparatus Required.**

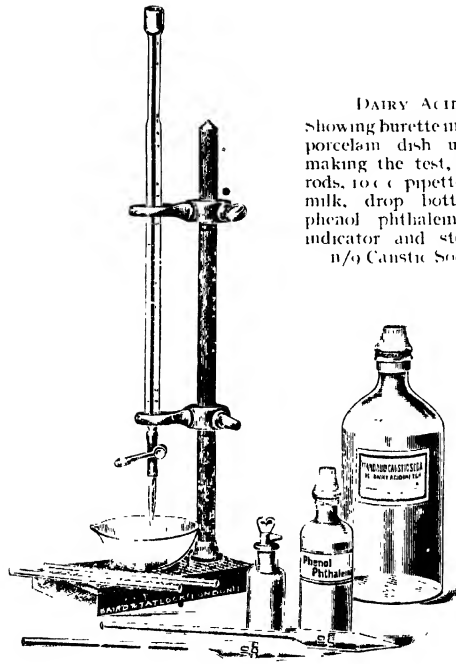
(1) A burette to contain the alkali solution, fixed on a stand. (2) An alkali solution (caustic soda is the the one nearly always used), of the correct strength. (3) The indicator (phenol phthalein) contained in a drop bottle. (4) A 10 c.c. pipette, or a measure of that capacity. (5) A small white porcelain dish, and a glass stirring rod. The whole of this apparatus, with a supply of the alkali and indicator, can be purchased for a few shillings.

As a matter of convenience the strength of the caustic soda used is such that the use of 1 c.c. indicates the presence of .01 (1·100th) of a gramme of lactic acid in the liquid to be tested. If twice this amount is needed before the pink colour is produced, then twice the amount—i.e., .02 of a gramme of lactic acid—is present in the 10 c.c. of liquid tested. The quantity of alkaline solution necessary will therefore serve as an accurate indication of the amount of lactic acid present in the liquid of which 10 c.c. have been taken. It is clear that the whole value of the test as an accurate means of finding the acidity depends upon the correctness of the alkaline solution. This is usually prepared by dissolving 4.5 grammes of 98 per cent. pure caustic soda in a litre

of distilled water, but it requires to be standardised by a skilled chemist, so must generally be purchased. Any firm of chemists will supply it, and the accuracy of the strength of the solution can then be relied on.

(59) How to use the Acidimeter.

The actual testing of a sample is carried out as follows:—Ten c.c. of the sample of milk or whey should be measured accurately, and placed in the basin. To this add three or four drops of the phenol phthalein liquid. A measured quantity of the caustic soda solution is placed in the burette, and allowed to fall, drop by drop, from the burette into the sample. Critical watch must be kept, and the sample must be well stirred The moment the pink tinge is apparent the addition of caustic soda must stop, and the number of cubic centimetres of this solution which have been added must be read off in the burette. If, as frequently happens with milk for certain kinds of cheese, is it found that 2.1 c.c. of he caustic soda have been used to neutralise the acidity in the sample, this shows the presence of .01 × 2.1 grammes of lactic acid in the 10 c.c. of the liquid tested. Hence in 100 c.c. of the sample there would be ten times this amount—that is, .01 × 2.1 × 10. This is .21 on the 100 of the sample, hence the acidity is .21 per cent. This calculation is simplified in practice by merely taking one-tenth of the amount of soda solution used, and the number thus obtained represents at once the percentage of acid in the sample. It is this simplicity in obtaining the percentage which has led to the method



DAIRY ACIDIMETER.

Showing burette in burette stand, porcelain dish underneath for making the test, glass stirring rods, 10 c c pipette for measuring milk, drop bottle containing pheaol phthalein solution or indicator and stock bottle of n/9 Caustic Soda solution.

being so readily adopted for use in the dairy. If the quantities taken are all measured accurately, the percentage of acid present can be read off at a glance, and it may always be taken that each cubic centimetre of soda used represents .1 per cent. of acid present in the liquid test.

(60) **Rennet Test for Acidity.**

Another test for acidity, which is applicable in the case of milk only, is known as the rennet test. Rennet works in conjunction with the acid in milk, and this test is based upon the time in which a given quantity of milk coagulates, with a given quantity of rennet, at a definite temperature. Under these set conditions the more acid the milk up to a certain point the quicker will be the coagulation. To carry out this test, measure out four fluid ounces of fresh milk and regulate it to a temperature of 84 deg. Fahr. Warm a tumbler or large rennet measure, and in the bottom of it place two or three small pieces of broken match, bits of straw, or cork and 3.5 c.c. (1 drachm) of rennet extract. Now pour the milk rapidly into the prepared glass, and stir quickly for ten seconds. This will cause the rennet to mix with the milk and the pieces of straw to rotate with it. The instant the milk has coagulated the straws will come to a standstill. The time from adding the milk to the glass containing the rennet, to when the milk has coagulated must be very carefully noted by the second hand of a watch. It is advisable to use a stop watch in order to obtain the best results. The sweeter the milk the greater the number of

seconds taken for the milk to coagulate, and vice versa, and when rennet of the same strength is used each time the test will show the acidity of the milk. A 23 to 24 second rennet test would be shown with milk containing about .19 per cent. of acidity.

CHAPTER IX.

THE NATURE, PREPARATION AND ACTION OF RENNET.

(61) Rennet.

The substance known to the cheesemaker as rennet, which is used for the purpose of producing curd, is of a complex nature, and powerful in its action. Rennet is a preparation extracted from the fourth stomach of young suckling calves, these stomachs being known to the cheesemaker as "vells." Rennet is a chemical or unorganised ferment. There are two active ferments in rennet, lab, or chrymosin, and pepsin; both of these belong to a class of ferments known as proteolytic ferments, or those which act on proteids or albuminoids. The proteid in milk on which the rennet acts is the casein, but it does not coagulate the other proteid known as albumin. There are certain conditions necessary for rennet to work properly, and the first of these is the presence of soluble lime salts, or salts of an alkaline nature in the milk. The lime salts must be in a soluble state in order to obtain a firm coagulum. When milk has been heated to a high temperature, which causes the soluble lime salts to become insoluble, the curd produced will be of a weak character. Below a temperature of 50 deg. F. and

above 130 deg. F., the activity of rennet practically ceases. For the proper action of rennet a certain amount of heat is necessary. The temperature at which rennet works best is about 105 degrees F., but this temperature cannot be used in cheese-making, as the curd produced would be too firm in character.

(62) Action of Rennet.

The following table, taken from Fleischmann, gives the speed at which rennet can perform its work at different temperatures.

Temperature.	Speed of Coagulation.
68 deg. F.	18
86	71
95	86
105-8	100
113	89
122	50

A temperature of 140 deg. F. will entirely destroy the action of rennet. There are always bacteria in rennet, but they do not assist its action. As a matter of fact, rennet would be better without bacteria, but it it is impossible to sterilise rennet to destroy the germs in it as the heat necessary would also destroy the ferments of this preparation. Rennet is stimulated by the acid in milk, but it is not entirely dependent on the presence of acidity in milk for its action, as it will coagulate milk that is slightly alkaline in character, but in this case the coagulation takes longer.

(63) Home-made Rennet.

The different forms of rennet include home-made rennet, rennet extract, rennet tablets, and rennet in the form of powder. To make home-made rennet three or four vells are got perfectly clean with a cloth, but not washed. Some salt is put on them, and when dry they are cut into strips, ready for use, placed in a gallon of water which has previously been boiled and cooled, and prepared by adding salt nearly as much as the water will dissolve. Two or three times a day the pieces of vells are rubbed between the hands so as to get the rennet out of the skin into the salt solution. The soaking period will take about five days, at the end of which time the rennet, after being carefully strained, is ready for use. Home-made rennet is about one-eighth the strength of rennet extract, and is used chiefly for Stilton cheese, in which case an ounce is used to coagulate five gallons of milk.

(64) Rennet Extract.

Rennet extract may be obtained in three forms, liquid, tablets and powder. The tablets and powder are easily dissolved in cold water, whilst the liquid extract must be diluted with clean water before use. Different brands of rennet vary in strength, and it is therefore necessary to have a standard of comparison for rennet. One part of standard rennet will coagulate 10,000 parts of milk in 40 minutes at a temperature of 95 degrees F. A good rennet extract should be clear in appearance, and of a yellow brown colour; it

should never be turbid, or possess a putrescent odour. Rennet tablets and powder prove useful in dairies where cheese is made only occasionally, also in hot countries where the solution will not keep well. Rennet extract contains some preservative, in order to prevent it from decomposing, which it readily does if unpreserved. The amount of preservative in rennet is very small, and as such a small proportion of rennet is added to the milk it should not be affected by the preservative. Different brands of extract vary from that of standard strength, and therefore when good results are secured from one particular kind of rennet it is advisable to use that brand always. Rennet must be stored in a cool, dark place, as even when kept under the best conditions it loses about a quarter of its strength in a year. Rennet is best kept in stone jars, as they help to keep it cool, and prevent decomposition from taking place.

(65) Rennet Measures.

As rennet extract is very strong it must be very accurately measured, or unsatisfactory results will obtain. Owing to the small quantity of rennet measured at a time, it is necessary that the measures be very accurately and suitably graduated. For soft cheese, where very small quantities indeed of rennet are required at a time, a suitable measure is a pipette graduated in cubic centimetres, each of which is sub-divided into tenth parts, or a drachm-size glass divided up into minims or drops. For larger quantities of milk, measures holding three or four

ounces and divided up into drachms or half-drachms are required. At factories, rennet measures of 16 ounces capacity, divided into ounces, are employed, in addition to the smaller-sized measures. It is advisable to keep a number of different sized measures on hand, so that different small quantities of rennet can be easily and accurately measured.

RENNET MEASURE OF CAPACITY.

17 minims or drops	..	..	..	1 c.c.
60 minims	..	..	..	1 drachm
3.35 c.c.s	..	..	..	1 drachm.
8 drachms	..	..	..	1 ounce.
20 ounces	..	..	..	1 pint.

The pint size measures are used only at cheese factories, where some 400 to 600 gallons of milk are made into cheese in one vat.

CHAPTER X.

STARTERS—THEIR NATURE AND METHODS OF PREPARATION.

(66) Pure Culture Starter.

A starter consists of a pure culture of the bacteria which decompose the milk sugar to form lactic acid, and may be described as a concentrated growth of the lactic-acid-producing bacteria. The function of a starter in cheesemaking is to assist in the acidifying, or ripening, of the milk and curd. In pure, clean milk, the starter employed merely hastens the development of acidity. In the case of contaminated milk, or that of doubtful quality as regards cleanliness, a larger proportion of starter is employed to counteract the ill-effects of the dirty milk. A slight taint in milk may be overcome by the judicious application of starter, but when milk is very badly contaminated the amount of starter necessary to overcome the taint would in all probability cause the finished cheese to become much too acid. The bacteria of a pure culture starter, in addition to producing lactic acid, also have the power of overcoming or crowding out various other species of bacteria which prove deleterious to the manufacture of a prime cheese. When a few of the lactic-acid-producing organisms are put in milk

containing various other kinds of germs, and the milk is kept at a favourable temperature for a number of hours, frequent bacteriological examinations will show that, as the lactic acid organisms increase in numbers, the other species of germs decrease.

(67) Two Forms of Starter.

The two forms of starter commonly used are (1) naturally prepared starter; (2) pure culture starter. Natural starters employed in the cheese-making dairy consist of soured milk, or whey saved from the previous day. The use of whey for a starter is, however, not to be recommended, as, although good results are often obtained, it is sometimes the cause of tainted produce. Even if the whey is kept in clean vessels and under the best conditions, a taint in the cheese one day will be transmitted by it to cheese made the next day.

(68) Preparation of Home Made Starter.

Where pure culture starters are not purchased, a specially prepared starter may be made in the following way:—First, obtain a quart or so of fresh milk from a healthy cow, and allow the milk to sour naturally in a pure atmosphere. The cow's udder must be well cleaned, and as the first milk drawn is always contaminated with undesirable bacteria, a little milk should be drawn off from each teat before obtaining that for the starter. Put the milk through a cotton-wool filter into a vessel which has just previously been thoroughly cleaned and well scalded.

Leave the milk in a clean, well-ventilated dairy, having a pure atmosphere, and in about twenty-four hours' time the milk will have soured sufficiently for re-cultivation. The air of a clean dairy is teeming with the acid-producing bacteria, and when these germs enter warm milk, they are in a medium specially adapted for their rapid multiplication. During the time the milk is souring it should be kept as near as possible to a temperature of 70 to 75 deg. F. When very carefully prepared, this starter is practically a pure culture.

(69) How to Re-cultivate the Starter.

The starter is cultivated in some freshly pasteurised milk. Pasteurised separated milk is preferable, as the fat of milk retards the development of lactic acid bacteria, and in the process of separation the milk gets thoroughly cleaned. If a separator is not at hand, ordinary fresh whole milk, or skimmed milk, may be used. To pasteurise milk it is heated to 185 deg. F. for ten minutes, then quickly cooled down to 70 or 75 deg. F. The reason for heating the milk to this high temperature is to destroy all the germs in it, so that when inoculated with the starter the acid-producing germs are practically the only species present in the milk. The top is skimmed off the starter and discarded, then the remainder is added to the freshly-pasteurised milk in the proportion of 6 to 10 per cent., or commonly one pint of starter to two gallons of milk. The inoculated milk is covered with a muslin cloth, and kept at a temperature of 70 to 75 deg. F. for twenty

to twenty-four hours, when after skimming off the surface the starter is ready for use and recultivation. A portion of the starter is added to pasteurised milk, as already described, for use the next day, and in this way a starter is kept available for some considerable time. It is, however, necessary to prepare a new starter occasionally, as the culture gets weak after a time through this specially "forced" method of growth.

(70) Preparation of Pure Culture Starter.

Pure culture starters are obtainable in liquid or powder form from most dairy appliance firms, or may be procured in liquid form from the nearest Dairy Institute.

Directions for preparing the starter in the first instance are given with the pure cultures, the usual method being as follows :—The culture is well stirred into some freshly pasteurised milk, regulated to a temperature of 80 to 90 deg. F., and maintained at this temperature for some twenty-four hours. The time taken for the first souring will depend upon the virility and quantity of the culture added to the prepared milk. When the milk has soured and is of a custard-like consistence, it is ready for recultivation after the surface has been skimmed off and thrown away. The surface of the culture may not be contaminated, but it is best discarded, in order to avoid any risk of contamination. The after cultivation is the same as that already described for the starter prepared from soured milk.

The chief *essential points for the successful production and maintenance of a starter are* :—(1) The use of clean utensils which have been thoroughly scalded just prior to use. (2) A really sound pure culture starter in the first instance. It is of no use to be continually re-cultivating a contaminated starter. (3) A clean, well ventilated room, the air of which is free from contaminating influences, in which to keep the starter. (4) Some means to maintain the starter at a suitable temperature. This should not be a difficult matter, especially as cheese is seldom made during cold weather. (5) Examination of the starter daily. It should be discarded as soon as it shows the least signs of going off. A good starter is of a sharp, clean acid flavour, and of a smooth silky consistence. The judicious use of a pure culture starter is of great value to the cheese-maker for controlling the acidity of the milk, and at times overcoming slight taints which otherwise would spoil the cheese altogether.

Care must be taken to keep the starter pure, as if contaminated its employment may lead to the production of much faulty cheese.

CHAPTER XI.

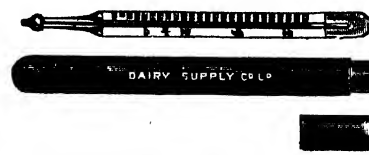
REQUIREMENTS OF THE CHEESEMAKING DAIRY.

(71) Dairy Thermometers.

In the manufacture of cheese it is most essential to work at correct temperatures, which are altered as required to suit varying circumstances. It is by the employment of suitable temperatures, in conjunction with other factors, that the production of the right kind of curd and the development of acidity is controlled In cases where the temperature of the milk, whey and curd is judged by the sense of feeling, the production of cheese of uniform quality cannot be assured. The correct temperatures throughout the process of manufacture can only be accurately determined by the use of a good thermometer.

For cheesemaking the most suitable means of ascertaining the temperature is by means of the ordinary floating dairy thermometer, which is obtainable from all firms supplying dairy appliances. The size of these thermometers is about 10 in. long by $\frac{3}{4}$ in. wide, and as the graduation marks—each representing two degrees—are about an eighth of an inch apart, the temperature can be quickly observed This type of thermometer is of glass, smooth on the

outside and having a paper scale inside. Thermometers having the scale scratched on the outside are not suitable for dairy work, as the graduation



FLOATING THERMOMETER AND CASE.

marks afford a harbour for stale milk and germs. These thermometers are marked "cheese" at the 85 degree mark; but this should not be taken notice of, as the renneting temperature should be varied according to numerous factors.

It is most important to procure thermometers that are guaranteed to be accurately graduated, as a few degrees wrong temperature is in some instances sufficient to spoil the whole of the milk being converted into cheese.

(72) Wall Thermometers.

WALL THERMOMETER.

Each apartment of the dairy should have a thermometer hanging on the wall so that at all times the temperature of the room may be ascertained. For this purpose the best kind of thermometer is one enclosed in a metal or wood frame. All thermometers in the dairy should be graduated on the Fahrenheit system, in which there are 180 degrees between freezing and boiling

points. If it should be necessary to use a Centigrade thermometer temporarily, the C. degrees may be converted to F. degrees as follows :—

(73) Comparison of Thermometer Scales.

On the scale of the Fahrenheit thermometer the freezing point is marked at 32 and the boiling point at 212, the space between these two points being divided into 180 equal degrees. The freezing point of the Centigrade scale is 0 and the boiling point is 100, the scale between the two points is divided into 100 equal parts, or degrees. Therefore, 100 deg. C.=180 deg. F. ; 5 deg. C.=9 deg. F. ; 1 deg. C.=1.8 deg. F. To convert Centigrade degrees into Fahrenheit degrees, multiply by 1.8 and add 32—*e.g.*, 20 deg. C. × 1.8=36+32=68 deg. F. To convert Fahrenheit degrees into Centigrade degrees, subtract 32 and divide by 1.8—*e.g.*, 68 deg. F.—32=36 ; divide by 1.8=20 deg. C.

(74) The Hygrometer.

In order to ripen cheese to the best advantage the air of the ripening room should be kept as near as possible to a certain degree of humidity, which is varied somewhat, according to the kinds of cheese in the room. The humidity of the atmosphere is ascertained by the use of an instrument known as a hygrometer, which is also termed a wet and dry bulb thermometer. The hygrometer consists of two ordinary narrow-stemmed thermometers fixed in a suitable frame. The bulb of one thermometer is wrapped in cotton cloth to which a loose cotton

string is attached. The string dips into a small receptacle of water placed just under the thermometer bulb, and the water rises up through the string, keeping the bulb wrapped in the cloth continually wet. Evaporation is constantly taking place at the wet bulb, and, on account of evaporation producing cold, this wet bulb thermometer registers a lower temperature than the dry one. In a very dry atmosphere evaporation will go on much quicker than in a damp air, and the dryer the air the greater will be the difference between the readings of the two thermometers. It is the difference between these two thermometer readings that gives indication as to the humidity of the atmosphere. With the hygrometer, tables are supplied which give the percentage of humidity in accordance with the difference in temperature recorded by the two thermometers.

(75) Salt.

It is absolutely necessary to procure only the very best salt for cheese-making, as inferior salt may easily spoil the flavour, texture, and colour of cheese. Common salt, which is chemically known as sodium chloride, is a compound of the metal sodium and the gas chlorine. Salt is found deposited in layers or beds in the earth, and is either dug up as salt or pumped up in the form of brine, the salt being obtained by evaporating off the water. The natural impurities of salt are many, and include chemical impurities, some of which give the salt a bitter flavour; others cause it to absorb water from the air and soon become damp, while other impurities render

the salt very insoluble. Further, there may be in very inferior salt earthy matter, and pan scale or cake from the pans in which the evaporating of the brine is done.

(76) Rough Test for Impurities.

A test for comparing different samples of salt for earthy impurities is to dissolve a quantity of each in several tumblers of hot water, and note the discoloration produced in the water, the amount of insoluble matter deposited, and the scum collected on the surface of the water. Insoluble matter, and pan scales produce white spots or blanched parts in a cheese. Very hard, insoluble salt does not get a proper chance to dissolve in cheese, as there is insufficient moisture present. The salt in such cases appears in the form of crystals when the cheese is cut. For butter-making, a soft, fine, readily soluble salt is required, but for cheese a coarser and slightly less soluble salt is best, as salt which dissolves too quickly gets lost in the whey escaping from the freshly made cheese. It is the most common practice now to add the salt in dry form to the curd and the practice of salting by "brining" or soaking the cheese in strong salt solutions is fast declining. When cheese are brined a readily soluble salt like that used for butter-making will answer best.

(77) Cheese Colouring.

Certain kinds of cheese are artificially coloured in order to meet the market demand, but apart from this there is no advantage in the practice, as it

does not improve the quality of the cheese in any way. The colouring matter added to the milk comes under two headings: (1) Preparations made from annatto; (2) aniline dyes. The former are harmless vegetable preparations, but aniline dyes are of a dangerous, poisonous character. Annatto is prepared from the seeds of a plant (*Bixa orallana*) that grows chiefly in South America and the West Indies. Annatto may be procured in the form of powder, and mixed with water before use, but is more commonly purchased in the ready prepared liquid form for use in the dairy. For colouring cream and butter, the annatto preparations are mixed with oil, but for cheese the colouring matter is dissolved in water, which mixes more readily with the milk. Although the colouring of cheese is not to be recommended, except to meet the demand for this class of produce, there is no harm in the use of annatto. Aniline dyes, although cheaper than annatto, should not on any account be used for the artificial colouring of dairy produce. It is a wonder that there is so much coloured cheese on the market, especially as everyone knows that cheese of various colours cannot be made from natural milk which is practically white in colour.

(78) **The Hot Iron Test.**

The milk and whey are tested for ripeness by the dairy acidimeter, but the curd is subjected to the hot iron test. This test is applicable to the curd only, and is sometimes described as the "hot iron acidity test." It is employed to ascertain the maturity of

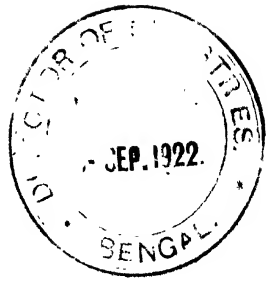
the curd, which is coincident with the acidity it contains. This test is a simple one, and needs no lengthy experience to enable one to use it successfully. All that is required is the iron itself and a fire in which to heat it. The hot iron ordinarily used consists of a piece of steel, usually about 1¼ in. wide by ¼ in. thick, and 6 in. to 8 in. long, excluding the handle. The method of using the iron is to heat it in a fire to a red heat, then allow it to cool until the redness disappears and it becomes black. The hot iron test can first be used just before the whey is drawn off, and again when the curd is on the cooler maturing prior to being milled. A small piece of curd is squeezed in the hand to get rid of as much moisture as possible, and is then put on the hot iron and gently drawn away. This causes strings of curd to draw out between the curd and the iron. By the length to which these strings can be drawn without breaking, the acidity or ripeness of the curd is estimated.

Although the length of the strings is of first importance, their character must also be taken into consideration. They should be extremely fine and thread-like, not coarse or thick in appearance. In the case of Cheddar cheese, if the strings are very fine and 1½ in. to 1¾ in. in length, the curd is considered ready for milling.

This property of the curd stringing out on the hot iron is not altogether dependent upon the percentage of acidity in the curd, as the following experiment will show:—Take a piece of sweet curd, which will not string on the hot iron, put it in a

solution of caustic soda or borax, etc., of an alkaline nature. Allow the curd to remain a short time, then apply to the hot iron, when it will be found to string perfectly as if it were acid. Any agent that has a slight solvent action on casein in the curd will cause it to string on the hot iron. In the ordinary course of cheesemaking the curd is not alkalised so that this test proves a reliable one.

HYGROMETER.
see paragraph 74.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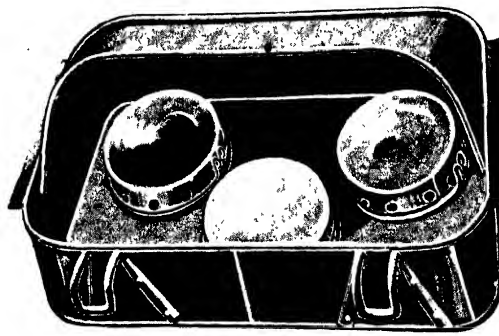
BENGAL



FACTORY OR LARGE SIZE COTTON WOOL MILK STRAINER.
Contains three filters and is attached to side of cheese vat or tank by means of clips

CHAPTER XII.

THE APPLIANCES FOR CHEESEMAKING.

Where cheese is to be made successfully, with as little labour as possible entailed, the dairy should contain all the necessary appliances for the manufacture of this product, and the following is a description of those chiefly required.

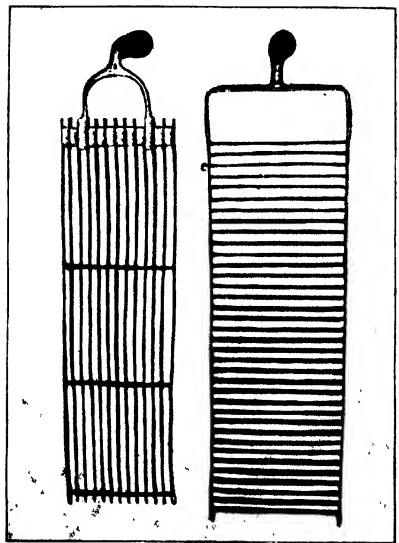
(79) Cheese Vat.

At farms where a small quantity of cheese only is made, the old-fashioned cheese tubs without jackets are still in use. The type of vat most commonly employed is rectangular in shape, and fitted with a jacket wherein hot water is placed, or cold water which is heated by steam. At the front of the vat there is a large tap through which the whey is run off, also two small taps fitted to the vat jacket. The two water taps are fitted one above the other, the upper one being used as an overflow to save the bursting of the inner lining in case the water is inadvertently left running into the vat. Small vats which can be easily lifted about are usually stood on a stool, or a small table, but the larger-sized ones, up to the factory vats holding 500 to 600 gallons, are on

wheels. Some vats are on four wheels, and fitted with a lever by which one end of this appliance is tilted when the whey is running off. The more common plan is to have two wheels under the middle of the vat—one leg at the back and two at the front. The front legs, which are shorter than that at the back, are blocked up when milk is in the vat, in order to keep it level. On drawing the whey these blocks are removed, and the short legs resting on the ground give the vat the necessary slope to allow the whey to drain out freely. A graduated metal strip may be hung inside the vat when full and level in order to ascertain what quantity of milk it contains. Another fitting is a metal strainer, which is fitted in front of the tap prior to drawing the whey, in order to prevent the small pieces of curd leaving the vat. At the back end of the vat jacket is a chute in which the water is poured, and a connection required for steam.

(80) Milk Strainer.

This is a most important appliance for the cheesemaker, and on no account should it be omitted. The best strainer, or filter, consists of two wire gauze discs of fine mesh, between which is placed a sheet of sterilised cottonwool, to act as the filtering medium. These filters are obtainable in various sizes according to the quantity of milk that has to pass through them. The factory-size cheese vats are fitted with large moveable strainers, having several filtering mediums. Above the cottonwool is fitted a lid-shaped piece of metal perforated all round the outside, which prevents the milk rapidly poured



AMERICAN CURD KNIVES.

A has vertical and B, horizontal cutting knives

the strainer from breaking the cottonwool and so allowing sediment to enter the vat.

(81) Curd Knives.

For the purpose of cutting the curd, specially constructed knives, known as American curd knives, are employed. Two knives are employed—one with vertical, the other with horizontal blades. There is also on the market a curd knife with diagonal blades, in which case one knife only is employed. This knife requires to be used with more skill than the American knives.

(82) Curd Cooler or Drainer.

This appliance is a receptacle about the same length and breadth as the vat with which it is used, and about 8 in. in depth. It is on legs, and a sufficient height from the ground for comfortable working. The interior of the cooler is of tinned iron, and may be fitted with a water-jacket—all are not—the water jacket being used on a cold day in order to prevent the curd being chilled. The drainer is fitted with wooden racks, which fit in the bottom of it. After the racks are covered with a cloth, the curd is placed on them to drain, and the whey escaping through the racks, leaves the cooler through a hole at one end.

(83) Curd Mill.

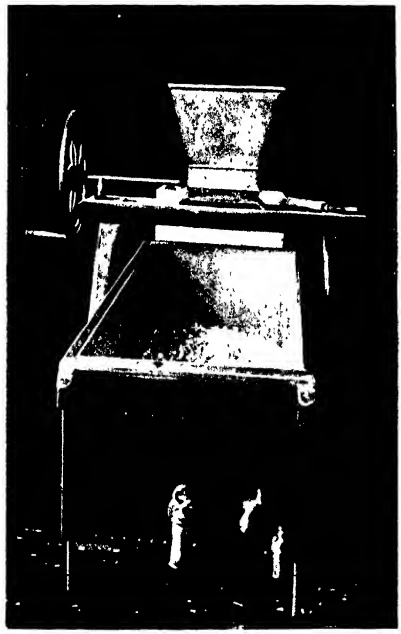
This appliance is used to reduce the ripened curd to small pieces instead of breaking it up by hand.

A CURD MILL.

The two chief parts of the curd mill are the hopper, in which the curd is put, and a spiked spindle meshing with a metal grating; this reduces the curd to small pieces of uniform size. Curd mills may be obtained on a stand, or to be fitted on the drainer. In cheese factories, the curd mill, or grinder, is generally worked by power.

(84) Curd Pail.

This is a specially constructed pail having one side flat. It is used for shovelling the curd from the vat to the drainer.



CURD MILL (on stand), placed over vat, which shows the curd after grinding.

(85) **Cheese Stool.**

This consists of a strong, heavy wooden stool, on which the cheeses are removed from the moulds when being turned, and on being bandaged after leaving the press.

(86) **Cheese Moulds.**

CHEESE MOULD OR CHESSET.

These are made of heavy wood or metal, the latter being more commonly used. The size and shape of the moulds depend entirely upon the size and the kind of cheese made. The milled curd is placed in the moulds until the cheese is sufficiently pressed, or, in the case of unpressed cheese, until it is sufficiently consolidated and drained.

(87) **Curd Rake.**

This consists of a long-handled wooden rake, with teeth on both sides and is used to stir the curd when a large quantity of milk is dealt with. In the case of small quantities the curd is usually stirred by hand.

(88) **Cheese Press.**

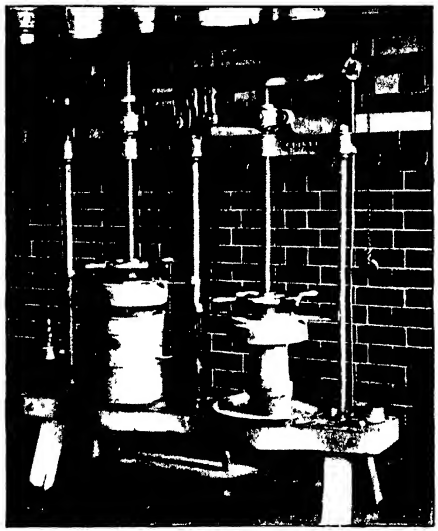
This appliance is used for pressing the curd in the moulds, and is capable of exerting a pressure of

Spring Cheese Press.

from 1 or 2 cwt. up to about 2 tons. The pressure is applied by regulating weights and levers except in the case of spring presses, where the compression of a powerful spring produces the needful pressure. Where a large number of large cheeses are pressed at a time gang presses are often employed.

(89) **Boiler.**

In small dairies where cheese-making only is carried on an open copper is usually employed for the purpose of obtaining hot water for heating the milk and washing the utensils. Where the quantity of milk dealt with warrants it, a small steam boiler is best employed for heating the milk and washing water, also for steaming out the cleaned utensils. In large cheese-making dairies a steam boiler is an absolute necessity. Whatever size steam boiler is employed, it must be fitted with a safety valve, steam-pressure gauge, and water-gauge. Before lighting the fire see that the water in the boiler is at least half way up the gauge, and get the steam up slowly so as not to force the boiler plates by heating



DOUBLE (Double Lever) CHEESE PRESS.

By means of weights on the cheese which are regulated up to 1½ tons, pressure can be exerted on the cheese.

	Height inches.	Diameter inches.	Weight about lbs.
Double Gloucester	9	14	30
Single Gloucester	4	15	16
Lancashire	13	7	35
Caerphilly	2½	10	8
Stilton	12	8	14
Wensleydale (Stilton Shape) ..	12	8	14
Wensleydale (Flat Shape) ..	5½	10	14
Dorset Blue	4½	10	12
Wiltshire	Between Loaf Cheddar and Double Gloucester.		

Cotherstone, similar to Wensleydale Stilton and flat shapes. Double Gloucester, 26 lb. to 30 lb. each. Single Gloucester, 13 lb. to 15 lb. each. Lancashire 12, 13 and 14 inches diameter for cheeses 30 lb. to 50 lb. each.

(91) Weighing Machine.

A weighing machine will be required for the purpose of weighing cheese and curd if necessary. The size of the machine will depend upon the maximum amount of cheese to be weighed at a time. A small pair of scales is sometimes employed to weigh the salt, etc., but if a weighing machine having the scale graduated to weigh quarter-pounds is bought a pair of scales will not be necessary.

(92) Salt Chest.

In order to keep the salt clean and dry, it should be stored in a thick air-tight wooden box or chest on legs to keep it off the ground, and have a close-fitting lid. The box should be made of some kind of close-grained wood that will not taint the salt.

(93) **Testing Apparatus.**

For the purpose of testing the milk for quality, cleanliness, and acidity, the following are required: Gerber tester and lactometer, Gerber tester for dirt in milk, acidimeter, a number of test tubes, glass jars, etc., for the fermentation tests.

(94) **Whey Tank.**

If the whey is sold to persons supplying the dairy with milk, an iron or galvanised iron tank would be required in which to store the whey if necessary. When very large quantities of whey need to be stored, a cement concrete tank is best. A chain pump will be needed to remove whey from same as required, if not built in an elevated position to empty by gravity. The persons taking the whey usually leave cans or tubs to be filled, but more often the whey is run into tanks and taken as required. On the cheese-making farm the whey is usually run through a trough to the pig tubs, or taken there in cans when the whey is drawn from the vat.

(95) **Sundries.**

Among the sundries required are: Floating thermometers, wall thermometers, Scotch hands, rennet measures, milk measures, steel pails for general use, enamelled pails for starter, brushes, cream skimmer, rennet, cheese cloth, salt, annatto, (if used), etc. The cost of equipping a cheese-making dairy will depend upon the size of it. Generally speaking, the cost of appliances and apparatus is smaller in proportion for a large dairy

than a small one. The quality of the utensils also affects the cost, but it is found cheapest in the end to purchase the best quality only.

The following is a list of the principal appliances and utensils required for a dairy dealing with 200 gallons of milk daily, and the approximate cost of the utensils, etc.:—

Cheese vat, 200 gallons capacity, with steam connections, etc.
Factory milk strainer.
Curd drainer and racks.
Two curd knives.
One curd rake.
One curd mill.
Three Cheddar moulds.
Two presses (double)
One cheese stool.
Gerber tester, four-bottle size, lactometer, etc.
One curd pail.
Dairy acidimeter and chemicals.
Floating Thermometers.
Two thermometers for walls.
Hygrometer.
Salt Chest.
Weighing machine.
Cream skimmer.
Steam boiler.
Two steel pails.
Two enamelled pails.
Hot Iron.
Rennet measures.
Milk measure, 1 quart.
Sundries, (rennet), salt, cheese cloth, brushes, etc.).

The equipment as given above at pre-war prices amounts to £90.

(96) Care in the Use and Preservation of Cheese-making Appliances.

In order to prolong the life of cheese-making appliances and to prevent their being a source of contamination to the milk and cheese, they must

be thoroughly cleaned immediately after use. Most of the utensils are made of tinned iron, and if the stale milk or whey is left in them for some time the acid in these liquids has the effect of gradually eating away the tin. When washing dairy utensils, first get them thoroughly clean with warm, not hot, water, then scald or steam them. Taints in dairy produce often arise through immersing dirty utensils in hot water, which causes the albuminous portion of the milk or whey to adhere to the vessels. This substance is soon decomposed by bacteria, and forms a source of contamination for the next lot of milk placed in the vessels. As soon as the curd is taken out of the vat, it should be washed with warm whey, then with warm water, and finally scalded or steamed.

For the cultivation of starter it is best to use glazed earthenware, or enamelled iron vessels, and when the latter are employed they should not be used for starter when the enamel is chipped off the inside, as the bare iron exposed would injure the flavour of the starter. At the end of the cheesemaking season all the utensils should be overhauled, and any that require it should be repaired instead of waiting until they are next wanted for use. Any vessels that are badly worn should be discarded, as they are often a source of contamination in the dairy. Before being stored for the winter the tinned utensils should be covered with a thin coat of vaseline in order to prevent rusting. The cheese presses should be painted and the working parts well oiled. The milk receptacle of the cheese vat should be covered with

vaseline. The outside of the milk receptacle and the inner side of the outer jacket should be painted over with red lead. To do this, the necessary screws are removed and the milk receptacle lifted out from the other one. The red lead will preserve the metal, and make it last many years longer than if untreated.

When the cheese vat is in use both of the short legs must be blocked up securely before putting any milk into the vat. When only one of the legs is blocked up, which is sometimes the case, the vat, especially if a long one, gets strained, causing it to leak. Sometimes a slight leakage is not noticed until the milk gets contaminated through coming into contact with dirty water in the vat jacket. Before using the appliances the next season they must be freed from the vaseline by being wiped with cloths, then washed in water containing some soda, etc. Thermometers, rennet glasses, etc., should be procured if necessary in good time so that when cheesemaking commences all will be in readiness. The dairy requires to be limewashed out, and if there are any cracks in the walls they must be filled in with the limewash.

CHAPTER XIII.

THE PROCESS AND METHODS OF CHEESE-MAKING.

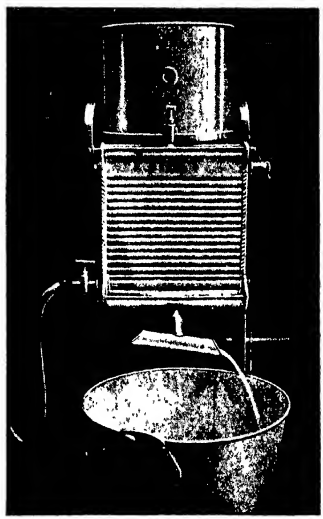
(9) The Process of Cheesemaking.

Most kinds of cheese are made from mixed milk—the evening's and next morning's milk being mixed together in the vat. It is a well-known fact that if warm milk fresh from the cow is left uncooled from the afternoon's milking it will, in hot weather, be sour by the following morning. For most varieties of cheese there should not be more than about .19 to .21 or at the outside, .22 per cent. of acidity in the milk before the rennet is added. The acidity in milk is caused by the lactic acid-producing bacteria, and in order to prevent the evening's milk becoming too sour by the next morning the activity of these bacteria must be checked. This is effected by cooling the milk to, and keeping it at, a fairly low temperature during the night. It is impossible to state a definite temperature to which the evening's milk should be cooled, as it is affected by several factors. When the nights are cold during the early and latter part of the cheesemaking season, it is a general practice to cool the night's milk to about 70 deg. F., and at other times in hot weather to cool the milk

to 60 deg. F. The object sought is to regulate the milk to such a temperature that the next morning when the fresh milk is added the mixed milk will contain about the right degree of acidity. When regulating the temperature of the evening's milk the fact that a large quantity of milk retains its heat better, and gathers acidity quicker than a small quantity, should be taken into consideration. It will, therefore, be necessary to cool a large quantity of milk to a lower temperature than a small one. A deep layer of milk requires more cooling than a shallow layer, and vice versa.

(98) Method of Cooling the Milk.

The usual method of cooling the milk is to run cold water through the jacket of the vat, and at the same time keep the milk in the vat gently stirred. This is not a very quick method, and when a large quantity has to be cooled a milk refrigerator or cooler is often employed. When a milk-cooler is used the milk gets aerated when being cooled, and this causes the cowy or other odours to leave the milk. A good plan is to have a milk vat fed from a cooler or aerator which is situated over or near the cheese vat. The warm milk is then passed through the filter, from which it flows on the cooler, and thence is conveyed into the vat. If the cooler is some distance from the vat the cooled milk is conveyed by means of an open metal channel. After a little practice the temperature of the evening's milk can be regulated to a nicety, so that it contains about the right percentage of acid by the next morning. This method of



MILK REFRIGERATOR.

Showing (*a*) feed pan in which the milk to be cooled is put ; (*b*) Refrigerator, milk runs over the surface and water inside. (*c*) Receiving pan in which the cooled milk is collected Ordinary railway churn may be placed under the cooler to receive the milk.

treating the milk is a good one where all the milk is produced under clean conditions on the farm, but if milk is purchased, and at all likely to be of doubtful cleanliness, it should all be reduced to a low temperature.

(99) Cooling Evening's Milk to Low Temperature.

Another method of treating the milk is to cool it to a low temperature of about 50 deg. F. in order to prevent the development of all the bacteria—both good and bad species—in the milk. If milk is contaminated with obnoxious organisms they would be likely to develop rapidly in warm milk during the night and taint the cheese. The next morning the milk is inoculated with a pure culture of the right kinds of organisms that produce lactic acid only in the milk. It is advisable to have the vat covered during the night with a muslin cloth in order to keep from the milk any dust or flies that may possibly enter the dairy. The wooden covers should not be left on the vat when it contains milk, except whilst the curd is forming.

(100) Skimming off the Cream.

A layer of cream will have risen on the milk during the night, but the cream cannot be thoroughly mixed in the milk by simply stirring it. All the cream must be skimmed off the milk, warmed up to about 100 deg. F., and returned to the vat with the fresh warm morning's milk, after the evening milk has been warmed to renneting temperature. It is important that the cream be skimmed off and warmed up, other-

wise it cannot be thoroughly incorporated in the milk, and then much fat gets lost in the whey, and the cheese becomes impoverished.

(101) Ripening the Milk.

Milk is considered ripe and ready for renneting when it contains a certain percentage of acid. The amount of acid required to be present in milk when it is ripe depends upon the kind of cheese to be made. The ripeness of milk is estimated by means of the dairy acidimeter or the rennet test. For making Wensleydale cheese the milk would be considered ripe when it contained .19 to .20 per cent. of acid, or showed a 23 to 24 second rennet test. For Cheddar cheese milk should contain .21 to .22 per cent. of acid, or show a 21 to 22 second rennet test. If the milk has been so manipulated that when the morning's milk is added the mixed milk contains the right percentage of acid, the contents of the vat may be regulated to the renneting temperature. As soon as the night's milk is creamed it should be tested for acidity, and, if it is sweet, warmed up to about 70 deg. F., and a little starter added in order to encourage the development of acidity.

(102) Adding the Starter.

In warm weather no starter need be employed if the milk is sufficiently acid without it, but in cold weather it is usual to use a small percentage of starter to bring on the acidity in the later stages of the cheesemaking, even if the milk is acid enough when mixed together. On a warm day, in addition to

the milk, whey, and curd retaining their heat better, the air is full of the acid-producing bacteria which enter the milk, etc., when the vat is not covered. In case of the evening's milk having been cooled to a low temperature, it will be quite sweet in the morning, and should be warmed up as soon as the cream has been removed. It will be necessary to add a fair proportion of starter to the milk, and to keep it warm until sufficient acidity has developed. If by the time all the morning's milk is added the whole is not ripe, then raise the mixed milk to the renneting temperature and keep it at that heat until ripe. It is impossible to prescribe a definite amount of starter for any one particular variety of cheese, so this must be left to the discretion of the cheese-maker, who after having had some experience will be able to estimate the right proportion of starter to employ. The amount of starter usually used in cheesemaking varies from ¼ to as much as 2 per cent., and the following will give some idea as to the conditions under which the quantity employed is varied.

Increase the proportion of starter above that normally used for any variety of cheese in the following instances: (1) With very sweet milk; (2) On a cold day; (3) With a very small quantity of milk; (4) When dealing with tainted milk; (5) If for any reason the cheese has to be made in a shorter time than usual.

Decrease the proportion of starter: (1) When the milk is acid (in case of over-ripe milk do not use any starter); (2) With a large quantity of milk; (3) In warm weather.

Some kinds of cheese, such as Stilton or Wensleydale, are often made without starter, except in cold weather or when the milk is tainted. A little starter is often beneficial, as it ensures the presence of the right kind of organisms in the cheese. The value of a pure culture starter for cheesemaking cannot be over-estimated when used judiciously, but when carelessly added to the milk very unsatisfactory results often accrue.

(103) **Method of Heating Milk for Cheese.**

The methods of heating the milk are dependent chiefly upon the type of cheese tub or vat used and the quantity of milk dealt with at the time. Where a small quantity of milk is made into cheese in vats or tubs which are not fitted with a steam or water jacket, the milk is regulated to the renneting temperature in the following manner:—A portion of the milk, usually about a fifth is taken from the tub, and heated up by placing the vessel containing the milk into another containing hot water, then returned to the bulk of the milk. This operation is repeated several times until the whole of the milk is at the desired temperature. As a means of ascertaining to what temperature the milk taken from the tub must be raised in order that on its being returned to the remainder of the milk the whole is warmed to the desired temperature, the following calculation is resorted to:—The total number of gallons of milk is multiplied by the number of degrees the temperature is to be raised. The result is then divided by the number of gallons taken out to be heated.

The result will give the number of degrees which the milk taken out must be raised, and may be expressed by the following formula :—

$$\frac{\text{Total gallons of milk} \times \text{Required degrees to be raised}}{\text{Number of gallons of milk heated.}} = \text{The necessary rise of temperature in the milk heated.}$$

Example :—Twenty gallons of milk at 80 deg. F. are to be raised to a temperature of 84 deg. F. Four gallons of milk are taken out to be heated, therefore the temperature by which this quantity must be raised is—

$$\frac{20 \times 4}{4} = 20.$$

Therefore if the 4 gallons of milk are raised 20 deg. F.—that is, heated to 100 deg. F.—when returned to the vat the bulk will be at a temperature of 84 deg. F. It is not advisable to heat milk to a very high temperature when it is to be converted into cheese, as by so doing the lime salts in the milk are rendered partly insoluble. The rennet works in conjunction with the lime salts in their natural state, and a good curd cannot be produced if the lime salts are insoluble. The natural enzyme in milk which assists in the ripening of cheese is weakened by subjecting the milk to a high temperature. On that account it is necessary to heat several small quantities of milk to about 100 degs. F. instead of raising one lot to a high temperature.

(104) **Heating Milk in Jacketed Vats.**

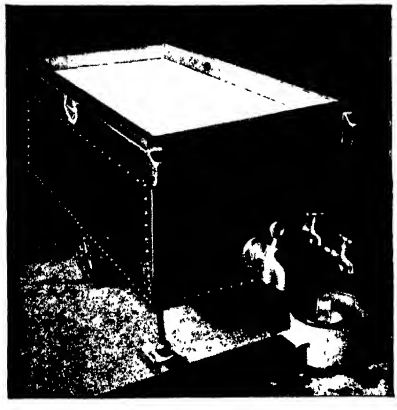
Although the old-fashioned tubs are still used on many farms, most of the cheese vats, even the small-

sized ones, are fitted with water jackets. In this case the milk is heated by being stirred in the vat, while hot water is poured in the jacket through the chute provided for that purpose. When the water is heated in an open copper, it may be syphoned into the vat jacket by means of a length of rubber hose pipe, thus saving the labour of carrying a number of pails of hot water to the vat. The method of manipulating the syphon is as follows :—

Fix one end of the rubber pipe on the small tap used for emptying the vat jacket, and weight the other end of the pipe with a piece of iron, or stone, etc. Have some water in the vat jacket, turn the tap on, and when the water runs through the pipe, stop up the weighted end with a cork and turn off the tap. The pipe will then be full of water, which cannot run out if the weighted end is raised above the level of the vat tap. Now place the end of the pipe in the copper, removing the cork just as the pipe is entering the water. If the tap is now turned on the hot water will be caused to syphon into the vat jacket, and the speed at which the water flows can be regulated by adjusting the tap. This method of heating milk has been found to answer with a 200-gallon cheese vat.

(105) Heating by Steam.

At dairies where large quantities of milk are daily made into cheese a steam boiler is installed, and the milk is heated by driving steam into water contained in the vat jacket. The steam heats the water, which in turn warms the milk. In order to avoid over-



Milk in Jacketed Vat Ready for Renneting.

heating the milk, the steam must be turned off when the milk is several degrees below the renneting temperature. If the water in the steam jacket is heated up very quickly, it may be found necessary to turn off the steam when the milk is about 10 deg. below the desired temperature. In the case of warming sweet milk very slowly, with a small pressure of steam, the steam may be required until the milk is within 2 deg. of the renneting temperature. The rate at which the milk should be heated depends upon the acidity of the milk. With sweet milk there is no advantage in raising the temperature quickly, but with over-ripe milk it should be got to the renneting temperature as quickly as possible.

(106) **The Renneting Temperature.**

The milk for most kinds of cheese is set, or renneted at different temperatures between 80 and 90 degrees F., according to the kind of cheese being made. There are certain temperatures at which the milk is normally renneted for different kinds of cheese, but in each case these temperatures must be varied a few degrees either way, according to circumstances. It is most important that the milk be set at the most suitable temperature for the particular kind of cheese being made, as this has some effect upon the nature of the curd produced. Among other factors, higher temperatures are adopted with rich milk, and in cold weather, and vice versa. Too high a setting temperature results in the production of a curd which is sufficiently firm for milling long before it is acid enough. Too low a temperature is the cause of a

weak curd, which readily parts with its fat, leaving the cheese hard and dry, and if the milk is ripe the curd will be much too acid before it is firm enough for milling. When the renneting temperature is either too high or too low, this leads to the curd ripening abnormally, and the production of a finished product of inferior quality.

(107) Colouring Milk for Cheese.

Some kinds of cheese, such as coloured Cheddar, Cheshire, and Leicester, are artificially coloured, the colouring matter being added to the milk. The proportion in which annatto is used is about one drachm to three gallons of milk for a dark-coloured cheese, and one drachm to five or six gallons of milk for a moderately coloured cheese. In many instances where cheeses are made in the early spring, or at times when milk is naturally very white in colour, a small proportion of annatto is used, about one drachm to thirty gallons of milk, to improve the colour of the cheese. Annatto must be very carefully added to the milk, or a discoloured cheese may result. First mix the annatto in a quart or so of warm milk, and add this mixture to the milk and stir it in well for ten minutes before the rennet is added. Take great care to have the colouring matter thoroughly distributed throughout the milk before the rennet is added, or the cheese will be patchy or streaky in colour. There is no set quantity of annatto to add to milk for cheese, so that this must be regulated according to the desired colour of the finished product.

(108) **Amount of Rennet Required.**

The chief factor influencing the amount of rennet to add to the milk is the variety of cheese being made. Other factors which influence the proportion of rennet employed are acidity, quality and quantity of milk, also the time of the year. Rich milk requires more rennet than milk of normal quality as in the former there is more solid matter for the rennet to act upon. Over-ripe or acid milk contains large numbers of the acidifying organisms, and during the process of cheesemaking the milk, whey and curd are kept at a temperature favourable to the development of these organisms. In this way, when the milk in the first place is very acid, the acid develops very quickly, and unless a sufficient amount of rennet is added to produce a rather firm curd quickly, the acid develops at a faster rate than the curd firms and drains. This is one cause of a very dry crumbly acid cheese.

For most kinds of cheese, except soft cheese, rennet is employed in the proportion of one drachm to three or four gallons of milk. This applies to the commercial rennet extract, but home-made rennet being much weaker, is used in a larger proportion. For Wensleydale and hard-pressed cheese the acidity of the milk, renneting temperature, and amount of rennet are so regulated that the curd is ready for cutting in from forty-five minutes to one hour's time. Milk for Stilton and some varieties of soft cheese is set at a lower temperature, and coagulated with less rennet, so that coagulation takes place in one and a

half to two and a half hours, and the curd is generally ladled out instead of being cut with knives. In the manufacture of cheese it is most important to ascertain the correct amount of rennet required for the kind of cheese being made, and to measure out the rennet accurately. Rennet extract is in a very concentrated form, and therefore a slight inaccuracy in the measuring will make a great difference in the consistency of the curd produced. When purchasing fresh rennet, always test its strength, and vary the proportion used if it is not of the same strength as that previously used.

Renneting.

Having ripened the milk and regulated it to the renneting temperature, the rennet is added after being diluted with several times its volume of clean, cold water. Unless the rennet extract is diluted, it will in a large vat begin to work before being distributed through the milk, which results in the formation of curd of uneven consistence. Thoroughly stir the rennet deeply into the milk for as long a time as it is safe to do so, the object being to get the rennet evenly distributed through the milk without over-stirring or allowing the cream to rise. Over-stirred milk is fatal to the production of good cheese, so must be avoided. Three minutes are sufficient to mix in the rennet, but a longer time ensures a more even distribution, and helps to keep the cream from rising. The period for which it is safe to stir deeply will depend upon the acidity of the milk. With .21 per cent. of acid present, it is safe to stir for six

minutes, with .23 per cent. four or five minutes, over .23 per cent. two and a half or three minutes. By all means prevent over-stirring. In case of overripe milk a matter of five seconds is quite sufficient to produce over-stirring. After stirring deeply for the requisite time, the surface of the milk is skimmed over with a Scotch hand to keep the cream down until the milk commences to coagulate, which may be detected by: (1) The milk hanging on the fingers after these have been dipped in the milk. (2) Take a glass of water and put a drop of milk in it. Before the milk commences to coagulate it will make the water milky; after, it will sink. (3) Put a drop of water on the milk and if the water disappears the milk has not begun to set. If the water lies on the surface of the milk, or makes a slight hole, cease stirring. Cover the vat with wooden lids, and leave the water in the vat jacket at about 2 deg. above the renneting temperature of the milk. This will maintain the milk at a uniform temperature throughout the coagulating period and so produce an even coagulum.

(109) **To Test Curd for Cutting.**

Cut the curd as soon as it is ready. There is no specified time at which it will be ready to cut, so this must be left to the discretion of the cheese-maker. One method of judging when the curd is ready for cutting is to press the hand upon it. If the curd is firm and pieces do not adhere to the hand, it is ready. Perhaps a more general method is to insert a dairy thermometer or a finger into the curd in a slanting direction, and on raising the thermometer, if the curd

breaks with a clean fracture, it is ready for cutting. It is most important that the curd be cut when ready, as cutting either too soon, or leaving it too long, must result in a considerable amount of fat being lost in the whey.

(110) **Method of Cutting.**

The cutting of the curd is an operation which must be very carefully performed, or nothing but a serious loss of fat can result. First insert the vertical knife, gently draw it through the curd, then cut with the horizontal knife. After cutting with both knives, the curd should be reduced to small cubes of uniform size. The vertical knife is used both lengthways and crossways, but the horizontal knife may be used one or both ways, according to the kind of cheese being made. With acid milk always cut the curd smaller, in order that the cubes may drain quickly.

As soon as the curd is cut, make an acid test of the whey, as the subsequent operations will have to be varied somewhat, according to the percentage of acid in the whey at this stage.

(111) **Loss of Acidity.**

It will be noticed that the whey after the curd is cut contains much less acidity than was contained in the ripened milk, instead of having increased as the acidity does when milk, or whey, is kept warm. This loss of acidity is due to the fact that in the coagulation of milk by rennet, certain salts of an alkaline nature are liberated and neutralise

CUTTING CURD

The operator is here shown using a vertical curd knife.

the acidity in the whey. After this, it will be found that the acidity will increase normally under the usual conditions.

(112) **Colour of the Whey.**

The whey should be of a greenish hue and clear, but if the cutting has been carelessly performed it will be whitish in colour and not at all clear. The more fat there is in the whey the whiter it will be. It will be noticed that when the curd is just cut, the whey will be white and rich-looking, but shortly afterwards the fat will seem to disappear and the whey assumes a greenish colour. This is explained by the fact that, however carefully the curd is cut there is always a little fat lost. When the curd is cut there is the fat in a very small quantity of whey, but as the process of manufacture proceeds, the volume of whey escaping from the curd increases tremendously, but with careful manipulation no more fat is present in the large volume of whey.

(113) **Treatment of the Curd after Cutting.**

The treatment of the freshly cut curd will depend upon its state, and the kind of cheese being made. With some varieties of cheese the curd is scalded immediately after being cut, while with others the curd is left twenty to thirty minutes between cutting and scalding. In the case of dealing with over-acid milk, the period between cutting and scalding is considerably shortened. In the production of some kinds of cheese the curd is not scalded, except in rare instances.

(114) Scalding the Curd.

Scalding curd consists of slowly raising the contents of the vat to the desired temperature. This may be effected by removing and heating a portion of the whey and returning it to the vat, or by means of hot water or steam, as described for heating the milk. The reason for scalding is to aid the expulsion of the whey and give the curd a little more firmness. It also helps to increase the acidity, and is a process of drying the curd. The maximum temperature of the scald will vary with the kind of cheese and the nature of the curd. In scalding, always raise the temperature very slowly at first or the cubes of curd will get hardened on the outside, and thus prevent the moisture inside from draining out. The temperature must not be raised quicker than at the rate of one degree in three minutes. Scald higher and at a slightly quicker rate if the milk is very acid, but do not scald to a high temperature with a sweet milk. A slightly higher scald is necessary for rich milk than for that of normal quality. The curd must be kept gently stirred during the scald in order to keep the cubes of curd apart. During the scald the acid in the whey will have increased to the extent of about .03 per cent.

In the manufacture of Cheddar cheese the maximum temperature of the scald is about 102 deg. Fahr., and the curd is got to a condition known to cheesemakers as "shotty." The maximum scald for a Wensleydale cheese would be about two or three degrees above the renneting temperature. The

curd for Stilton cheese is not scalded at all. When the operation of scalding is completed the whey is either drawn off or the curd allowed to " pitch, " but this is decided after testing the curd and whey for acidity.

(115) Pitching the Curd.

In cheesemaking the term " pitching " is applied to the act of allowing the curd to remain in the whey undisturbed after being scalded. In some cases the curd is not scalded and is allowed to pitch after being cut and stirred for a time. Pitching assists the curd to mat together and bring on the acidity. If much acid is present it is not advisable to allow the curd to pitch, but when having to contend with a deficiency of acid the pitching period should be somewhat prolonged. The acidity in the curd always develops quicker when it is left in the warm whey. There is more milk sugar present in the whey than in curd, and it is the milk sugar which is converted into lactic acid by bacteria.

(116) Drawing off the Whey.

When there is sufficient acid in the whey for the variety of cheese being produced, the whey is drawn off and the curd is ripened in the vat if a small quantity, or on the curd cooler if there is a lot of curd. It is most essential to keep the curd in the whey until it contains sufficient acid, as drawing the whey too soon makes it difficult to ripen the curd properly, especially in cold weather. If left too long in the

whey the curd gets too acid, and this is one cause of sour, dry cheese.

(117) Ripening the Curd.

Curd is considered ripe when it contains the correct percentage of acid and moisture, and is of the right consistence for the particular variety of cheese being made. It is imperative that the curd be properly ripened before it is broken by hand or milled. The curd for a Cheddar cheese would contain when ripe about .89 per cent. of acidity, is of a fairly tough consistence, and has present in it about 40-45 per cent. of moisture. The curd of a Wensleydale cheese, which is only lightly pressed, when ripe would contain .35 to .4 per cent. of acidity, is moister, and much more tender than a Cheddar curd.

The curd for a Stilton cheese, which is not pressed at all, contains when ripe about the same percentage of acid as Wensleydale-curd, but is softer and much moister. When ripening the curd from a small quantity of milk—that is, about enough to make a couple of cheese or so—on running off the whey the curd is tied up in one or more cloths, and left in the vat.

In twenty to thirty minutes' time the cloths are opened and the curd cut up into cubes about nine inches in size, and again tied up in the cloths. Every subsequent fifteen to twenty minutes the cubes of curd are cut or pulled apart and again tied up, this being repeated until the curd is ripe. At each opening out the cubes of curd are cut up smaller until they finally become about three inches in size,

which is done to facilitate drainage and check the over-rapid development of acid. Acid and hot-iron tests are continually made, and if the curd is draining slowly, in proportion to the development of acidity, a weight of about 14 lbs. is placed on each clothful of curd to express the moisture.

A larger amount of curd is sometimes cut into blocks, and ripened in the vat without being put in cloths, the blocks being turned, and weighted if necessary. With large quantities of milk, say, from 200 to 500 gallons, when the whey is drawn, the curd is shovelled or bucketted on the cooler, which has previously been prepared with the racks, covered with a clean cloth. The curd soon assumes a large compact mass, which is cut up into 3 or 4-in. blocks, which are piled up two or three layers deep. These blocks are turned every fifteen minutes or so in order to facilitate the drainage of the whey, and to produce a uniform ripening of the curd. It is not often necessary to place weights on a large amount of curd if it has been treated properly up to this stage, unless the milk in the first place was over-ripe.

Points to observe in Ripening Curd.

The following points should be observed in ripening either a large or small amount of curd :—(1) In cold weather keep the curd covered with cloths, as, if the curd is allowed to get cold, the development of acidity ceases. (2) When the acidity is developing slowly do not turn the curd very often, and keep it in as compact a form as possible. (3) Do not weight

the curd too soon, as the whey is required in it for the acid to increase. (4) A small lot of curd does not require to be opened out and turned so often as a large one, unless the acidity is developing with undue rapidity. (5) If the curd is draining slowly and the acidity increases quickly, turn the curd frequently and weight it.

The chief point in the ripening of the curd is so to manipulate it that, when acid enough for vatting, it has drained sufficiently. An excess of moisture in the curd causes pressed cheese to crack open, and lightly pressed or unpressed cheese to ferment wrongly instead of ripening normally. A deficiency of moisture in the curd spoils the flavour and consistency of the resulting cheese, causing it to be lacking in mellowness when ripe. It is not a difficult matter to ripen the curd when about the same quantity of milk is dealt with daily, but at factories, where the surplus milk, varying from 50 to 500 gallons, is made into cheese, more skill is required to ripen the curd properly.

(118) **Breaking the Curd.**

The ripened curd is broken by hand into pieces about the size of walnuts, and this operation, although seemingly a simple one, calls for great care, otherwise a serious loss of fat will occur. A considerable loss of fat takes place at this stage, but with care this loss is greatly reduced. The object should be to break the curd into small pieces without squeezing it in the hand.

(119) Milling or Grinding Curd.

Where several cheeses are made at a time, especially at factories, a curd mill or grinder is employed to break the curd. More fat is lost by use of the mill than when the curd is broken skilfully by hand, but if the mill is judiciously fed and worked the inevitable loss of fat is kept within bounds. The firmer the curd the less fat is lost in the breaking or milling.

The broken curd is spread over the cooler or drainer, and sprinkled with salt, the proportion of which varies with different varieties of cheese. For a Cheddar cheese the proportion of salt used usually is 1 oz. to every 3 lbs. of curd. It is only possible to weigh the curd from a small quantity of milk. At cheese factories the weight of curd obtained per gallon of milk at different parts of the season is ascertained, and in this way the amount of salt to add is arrived at. It is usually added at so much per hundred gallons of milk employed, and this will vary from 2 to 3 lbs of salt to the curd from every 100 gallons of milk. The salted curd is thoroughly mixed up with the hands to distribute the salt, and then vatted if at the correct temperature. The application of salt gives the cheese some flavour and thus makes it palatable, while the salt also preserves the cheese to some extent. The salt in dissolving also reduces the temperature of the curd, which when freshly milled is usually too warm for vatting. When the curd is rather wet add more salt, and vice versa. As the salt dissolves, it extracts the moisture from the curd. In the case of wet curd there is more

moisture draining from the cheese, and with the moisture some of the salt escapes. In early spring more salt should be added to curd as the milk then, owing to winter feeding of the cattle, produces cheese lacking in flavour, and salt helps to make up for this to some extent. If the curd is at all tainted it should be spread out in as thin a layer as possible, stirred until vatted, and more salt than usual should be added. The stirring aerates the curd and partly rids it of the taint, while the extra salt helps to cover slight defects in the flavour of the finished cheese.

(120) Vatting or Moulding the Curd.

Vatting the curd is the term applied to the act of putting it in the moulds, sometimes termed cheese vats. The temperature of the freshly ground curd may be from 80 to 95 deg. F., but on no account must it be vatted until its temperature has fallen to 70 deg. F., or lower, or a lot of fat will be lost and spoil the flavour and texture of the cheese. Curd which is vatted too warm has a lot of fat expressed from it when put under the press. Cheddar curd is packed and pressed in the moulds, but curd of a more tender nature, such as for lightly pressed or unpressed cheese, must not be pressed too firmly when vatting, or much fat will be lost. When vatting curd for blue-veined cheese, it is usual to put the smaller pieces of curd at the bottom and sides of the mould, and work the largest pieces to the centre. This facilitates the growth of blue mould in the cheese to some extent by leaving the texture

open and providing air in the spaces in the cheese essential for the growth of blue mould.

(121) When to Press.

In the manufacture of most kinds of pressed cheese the curd, after being vatted is put under the press and some pressure applied. The time which elapses between vatting and pressing the curd, also the amount of pressure applied, will depend upon the variety of cheese made. Hard-pressed varieties of cheese require great pressure in order to consolidate and make them go together nicely, while the application of much pressure to other varieties of cheese would ruin them. Some kinds of cheese are put to press immediately after the curd is vatted, others a few hours after. When the curd is of a rather tender nature the pressing takes place either in the evening or is left till the next morning. The length of time which the cheeses are under pressure varies from a few hours to three or four days, depending upon the nature of the curd. The firmer the curd when vatted, the sooner is the cheese put to press and the longer the pressing period. A tough, firm, acid curd, like a Cheddar curd, must be pressed early and under a good pressure, otherwise the curd will not go together nicely and will be of an open texture, which is not required in this variety. The moulds are lined with a cloth previous to being filled with curd for most kinds of cheese. Some makers of Wensleydale cheese put the curd in unlined moulds, others line the moulds with coarse-textured cloths in the usual way, but, whichever method is adopted,

the cheese should be turned and put into fine cloths before being pressed. The curd should be level on the surface, and the followers set squarely on the curd, so that it gets evenly pressed.

(122) **Pressing Cheese.**

The curd is pressed in order to consolidate it and to express the superfluous moisture. The shape of the cheese is determined by the shape of the mould, but the texture is dependent upon the consistence of the curd and the pressure it receives. Unpressed cheeses, which are made from soft, moist, tender curds, drain sufficiently by gravitation, natural influences, and evaporation. Whatever pressure is applied to any one kind of cheese, it is most imperative that only a little pressure be applied at first, and gradually increased until the cheese is under the maximum pressure. Applying too much pressure at first, causes a lot of fat to be expelled from the cheese ; it forms a hard coat and prevents the cheese draining properly.

If two cheeses are placed one on top of the other, the lower cheese has the weight of the one above it in addition to the pressure exerted by the press. Two cheeses side by side require double the pressure applied, as each cheese is bearing half the pressure.

(123) **Bandaging Cheese.**

After leaving the press cheeses are bandaged before being taken to the ripening room. The bandages keep the cheese in shape, preserve its coat,

prevent some loss by evaporation, and keep flies, etc., from the cheese. There are different methods of bandaging different kinds of cheese. The bandages are usually sewn on, but at factories they are often pasted on and the cheese put back under press to press the bandage into the coat and give a smooth finish.

(124) **Brining Cheese.**

Some kinds of cheese are soaked in brine on leaving the press, for periods varying from a few hours to two days, according to the size and the variety. This method of salting cheese is fast declining, as there are no means of ascertaining how much brine the cheese has absorbed; the brine very often does not penetrate to the centre of the cheese—in short, the equal distribution of salt through the cheese cannot be ensured.

CHAPTER XIV.

THE RIPENING OR CURING OF CHEESE.

Cheeses are usually left in the making room for about three days after taken from the press, then put into the ripening room. The curing room is fitted with shelves round the walls and on stands conveniently situated in the room. It is a great advantage to have an underground ripening room in order that it may not be too hot during the summer months and to obtain equability of temperature as far as possible throughout the year. The best temperature at which to ripen cheese depends to some extend upon the kind made. Some kinds are best ripened at slightly different temperatures from others. Most varieties of hard-pressed cheese ripen to the best advantage at a temperature of 60 to 65 degrees Fahr., while many varieties of blue-veined cheese should not be ripened at a much higher temperature than 50 deg. Fahr. in order to obtain the best results. Most kinds of soft cheese are best kept at a temperature of 62 deg. Fahr. for the first three or four days in order to facilitate the growth of mould on the outside, then taken to a room having a temperature of about 50 deg. Fahr. Too high a temperature in the ripening room causes the cheese to "run" or exude fat and moisture, which of

course detracts from the quality of the ripened product. It is not a bad sign for some kinds of blue-veined cheese to leak whey slightly during the early part of the ripening period, but excessive leakage ruins the cheese. Cheese ripened at too high a temperature evaporates unduly, and this, besides causing it to lose weight, also makes it hard and dry. Another effect of too high a temperature is to turn the cheese rancid in flavour.

While a high temperature proves detrimental to successful cheese ripening, a low temperature has not that effect. Cheeses are sometimes ripened in cold storage. This prolongs the ripening period, but although the flavour of the cheese is good, it cannot be said to be so prime as that of a cheese which is ripened at 50 to 60 deg. Fahr.

(125) Ventilation of Cheese Ripening Room.

An important point in the ripening of cheese is to keep the room clean, well ventilated, and the atmosphere at a suitable degree of humidity for the variety therein. The more moisture contained in the variety of cheese taken to the curing room, and the more open the texture, the more humid should the air of the room be. Soft cheese which contains a lot of moisture requires to be ripened in a room having a very humid atmosphere, containing about 95 per cent. of humidity in order to prevent undue evaporation. The humidity of the air is ascertained by means of an hygrometer, and should be regulated accordingly. It is seldom that the room is too damp, it is generally too dry, but this may be overcome by damping

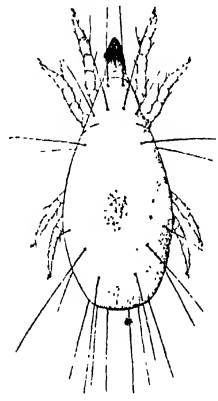
the floor daily and hanging up wet cloths. The disadvantage of the air being too dry is that it causes the cheeses to shrink unduly, crack, and become dry, while if the air is too damp it generally causes undesirable moulds to grow on the cheese, and this is likely to interfere with their normal ripening.

(126) Turning the Cheese.

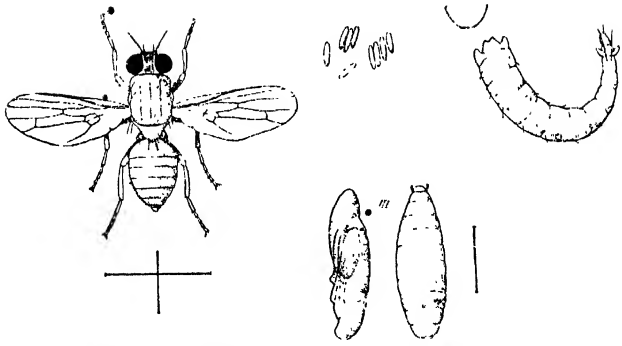
It is important to turn the cheese once daily for the first few weeks of the ripening period. After this, when the cheese becomes dry, turning every second day will suffice. Failure to turn cheeses, especially when freshly made, causes them to stick to the shelves, and any whey draining away ferments under the cheeses with bad results.

(127) Cheese Flies and Mites.

During the hot weather cheese are commonly attacked by cheese-flies. These are small black glistening flies about three-sixteenths of an inch in length, and have transparent wings. They lay eggs in the cracks in cheese, and in about thirty-six to forty-eight hours afterwards maggots, which are also known as skippers, hatch out from the eggs. The maggot feeds on the cheese for about two weeks, and then turns to a golden-brown puparium, from which a fully developed fly emerges in about ten days' time. About three generations are produced during the summer, and in cold weather these pests exist in the puparium stage. The maggots, in addition to feeding on the cheese, also encourage bacterial de-



CHEESE MITE (*Acarus Siro*).
As seen under the microscope.



CHEESE FLY (*Piophila casei*) WITH EGGS, LARVÆ, AND PUPÆ.

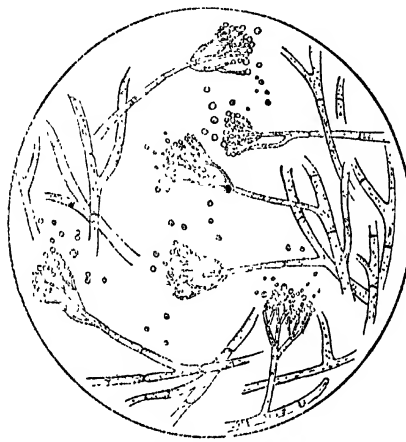
This fly is a small, black fly, about $\frac{3}{16}$ inch long. It lays its eggs in cheese, which hatch into maggots (cheese skippers or jumpers) in from 36 hours to 4 days. The grub feeds for about 15 days and then turns into a golden brown pupa, which changes into the fly in about 10 days.

composition of an objectionable nature to take place, and spoil the cheese. *Cheese mites* attack the coats of Stilton, Wensleydale, and other cheese when they are getting ripe, but do not attack fresh cheese. Cheese mites multiply rapidly, and do a lot of harm in the ripening room by causing the coats of cheese and frequently the whole cheese to crumble and waste away.

(128) Examining the Cheese.

During the ripening period the cheeses should be examined two or three times a week, and this is best done at the time of turning them. Any cracks in cheeses should be filled with lard or whey butter, etc., to prevent the flies laying their eggs therein. Another method is to paste a piece of cheese cloth over the crack. Some varieties of blue-mould cheese are skewered when in the ripening room, and in this case the holes should be filled in each end to prevent flies laying eggs in the cheese. Cheese flies prove most troublesome during the daytime, and are practically dormant during the night. Therefore, when the flies are troublesome, the ripening room should be kept dark by drawing the blinds, or tacking brown paper over the windows. It is advisable to hang several fly-papers in the room, by which a great number of flies will be destroyed. When cheese mites are present the cheese should be brushed daily, and if much damage is being done, the cheese may be dipped in hot water to destroy the mites. Smearing the cheese with grease keeps the mites off, but this course is not always to be recommended. In the

case of blue-mould cheese a coat of grease would make the cheese air-tight, and prove detrimental to the growth of mould in the cheese. Each day's make of cheese should be kept separate, and tested



THE MOULD PENICILLIUAM GLAUCUM, SHOWING THE SPORE FORMATION.

This is the mould which produces the blue veining in Stilton, Wensleydale and other blue cheese.

after being in the ripening room a few weeks. Any cheeses that are faulty should be disposed of as soon as possible, as a faulty cheese generally gets worse for keeping, and is sure not to improve.

(129) Loss of Weight in Ripening Cheese.

There is a great difference in the percentage of weight lost in the ripening of different varieties of

cheese. The chief factors affecting the loss of weight are the percentage of moisture contained in the cheese when taken to the ripening room, the texture of the cheese, the temperature and humidity of the curing room, and the size and shape of the cheese. The cheese containing the most moisture in the first instance loses most in weight when ripened under the same conditions as a comparatively dry cheese. The size of the cheese affects the loss by evaporation. A cheese weighing 90 lb. to 100 lb. will lose much less in weight during ripening than a cheese of the same kind which weighs only about 12 lb. to 14 lb.

In the case of hard-pressed cheese, the following figures show the approximate loss of weight of different sized cheese when ripened under favourable conditions.

12 lb.	cheese	about 15	per cent.	of their weight	while ripening.
30 lb.	,,	9 to 10	,,	,,	,, ,,
90 lb.	,,	5 to 6	,,	,,	,, ,,

The shape of the cheese has some effect upon the percentage of weight lost by evaporation of moisture. A flat cheese of large diameter, and about 3 in. or 4 in. thick, would lose more weight than a cheese of a much smaller diameter and a greater height. The texture of the cheese is another factor influencing the loss. A cheese of a close texture, like that of a Cheddar, loses much less than an open-textured cheese. The blue-veined cheeses are of open texture, and contain a lot of moisture, therefore they require to be ripened in a humid atmosphere, otherwise they soon become too dry. The higher the temperature of the ripening room the more moisture

will any kind of cheese lose in weight by evaporation. The humidity of the air must also be taken into consideration, and while the air is not kept too moist, it must not be too dry, as this would cause any kind of cheese to evaporate unduly, producing excessive loss in weight and inferior cheese.

CHAPTER XV.

THE MARKETING OR DISPOSAL OF CHEESE.

The best kinds of cheese to make, from a commercial point of view, are those for which there is the greatest demand in the district where the cheeses are to be sold. Most varieties of cheese can be sold when comparatively new, that is, a few weeks old, or be kept and ripened properly. In some instances, where a particular kind of cheese is to be sold when fresh, the process of manufacture is altered slightly so that the cheese will ripen quickly.

(130) Quick Ripening Cheese.

Where a quick-ripening cheese is made quick returns are secured for the money outlay and much labour is saved, as during a long ripening period the cheeses have to be turned three or four times a week, and a considerable loss in weight due to evaporation of moisture is sustained. Quick-ripening cheese contains a fairly high percentage of moisture, which gives a maximum yield of cheese from the milk utilised. During the early part of the season, when the milk is not at its best for cheese-making, it is advisable to make quick-ripening cheeses, and market them as soon as they are ready. Later in the season, when the cows are on good pastures

and yield milk from which prime cheese, having good keeping properties, can be made, it is then best to make cheese to be ripened slowly, unless a very remunerative price can be secured for fresh cheese. Unless a good price and a ready sale are obtainable for quick-ripening or new cheeses it is not advisable to make them except at the beginning of the season. Quick-ripening cheese contains a high percentage of moisture, which is favourable to the development of various species of bacteria and moulds. This renders it more difficult to control the ripening and produce cheese of uniform character, which is a great point in making cheese for market. This type of cheese must be sold as soon as ripe, otherwise it deteriorates in quality. Although slow-ripening cheeses cost more to produce, they are more uniform in character, and when ripe will keep a considerable time, which enables them to be disposed of at a time when the best prices can be secured.

There is always a good demand for a slowly ripened cheese of good quality. It is, however, advisable to examine cheeses during the early stages of the ripening period, and to get rid of any that are not of prime quality, as after keeping inferior cheeses for some months they have finally to be sold at a low price.

(131) Small Sized Cheese.

Most kinds of cheese are made in several sizes, and it is always more profitable to make large cheeses unless an increased price per pound can be obtained for small ones. The smaller the cheeses, the more

they lose in weight while ripening, the more labour has to be expended on them, and if not sold when ripe they soon become dry. It is generally advantageous to make some small-sized cheeses for the Christmas trade, as at this time of the year many people will pay a reasonable price for a small whole cheese in preference to purchasing a piece of a large cheese.

Some kinds of cheese are made to ripen slowly, but some are sold when a few weeks old. Cheese should be sold when quite new or kept till fully ripe. It is very seldom advisable to sell a half-ripe cheese, as after losing a good deal of weight in the ripening room it realises a price generally very little above that obtained for a new cheese, and if kept till fully ripe a considerably higher price would be secured for the cheese. When sending to market or to wholesale firms, it is most important that all the cheeses should be of good and uniform quality. Any cheese of inferior quality should be sold as such. This will give the dairy a good reputation, and a better price all round will be realised than if a cheese or two of inferior quality be included in a consignment.

CHAPTER XVI.

FAULTS OR DEFECTS IN CHEESE.

The faults of cheese may be classed under two headings :—(1) Faults due to the milk being contaminated. (2) Faults which are the result of defects in the process of manufacture; or the finished cheese not receiving proper attention.

(132) Spongy Curd.

This trouble which many cheesemakers experience is caused by the milk, and consequently the curd, being contaminated with gas-producing bacteria. When the milk is very badly contaminated, as soon as the curd is cut small particles rise to the surface of the whey, and sometimes fairly large pieces of curd will float on the whey, otherwise the work of these organisms is not noticeable until the curd is being ripened. The term "spongy" curd describes a curd which has become charged with gas, causing it to swell and become of a sponge-like consistence. When a piece of spongy curd is cut through and examined, it will be found to be full of small holes, the numbers of which will depend upon the extent to which the curd is contaminated. The holes are caused by the gas produced by bacteria. Cheeses made from spongy curd generally swell and burst when in the

ripening room. A number of different species of germs produce gas in milk curd and cheese, but the two species most commonly responsible for this trouble are Bacillus coli communis and Bacillus Guillebeau. The most common cause of spongy curd is dirty milk which contains large numbers of the coli organisms. These germs are present in the intestinal tract of all animals, and exist in large numbers in cow dung, etc. Milk which is drawn in a dirty manner is contaminated with these gas-producing bacteria, and if left warm in the cowshed it gets further contaminated with them, as they multiply rapidly in warm milk. Another source of contamination is the dirty drinking water which cows obtain from ponds of stagnant water, or ponds containing cowdung. During the hot weather it is not unusual for cows to stand in ponds, or a stream of water, whenever possible. When the water is contaminated with cowdung or through sewage being discharged into it, the water contains innumerable organisms of the gas-producing species. When cows wade in water of this kind their legs and teats become laden with the coli communis organisms, which get rubbed off into the milk at the time of milking. Fowls should not be kept near the dairy, as their droppings contain large numbers of the coli communis organisms. In many cases spongy curd has been traced to fowl droppings, which in the form of dust have entered the dairy or the clean utensils left outside the dairy. Where the milk is produced and handled under the best conditions, spongy curd is often the result of the cow

having a diseased udder, in which case the milk when in the udder is badly contaminated with gas-producing bacteria, chiefly of the species Bacillus Guillebeau. In this case the cow yielding the bad milk should be discovered by means of the fermentation tests.

(133) Tainted Cheese.

Tainted cheese is due to the milk in the first instance being contaminated with undesirable kinds of bacteria, or smells absorbed by the milk. The remedy for odour-tainted cheese is to keep the air of the cowshed as free as possible from smells while the milking is going on. Remove the milk from the cowhouse as soon as each cow is milked, and keep the air of the dairy pure. There are numerous species of bacteria which produce bad flavours in cheese. The chief source of bacterial contamination is uncleanness in the production and handling of the milk, or the presence of diseased cows in the herd. Tainted cheese is sometimes the result of unclean or badly-worn utensils, which are a fruitful source of contamination with the obnoxious species of bacteria. A *bitter flavour* in cheese is produced by certain species of bacteria and yeasts, also by the use of inferior salt. Defective drainage in the dairy is in some cases the cause of tainted cheese, through the milk which is left in the dairy during the night becoming contaminated. Milk from cows in service often causes the cheese to have a *fishy flavour*. The *vinegar taint* is due to the milk being contaminated with a species of bacteria which has

the power of producing vinegar or acetic acid. A putrid flavour in cheese is chiefly caused by using milk containing colostrum or beastings. This is really a bacterial taint, as colostrum contains a very high percentage of albuminous matter to which the bacteria producing decay and putrefaction are very partial. Cheese containing colostrum generally goes putrid, and if only a very small percentage of colostrum is present the cheese cannot ripen normally. Among other taints caused by bacteria is an objectionable flavour produced by the species of bacteria that cause the curd to be of a spongy nature.

Many of the bacterial taints in cheese are due to the development of insufficient acidity in the milk and curd. Milk contains innumerable varieties of bacteria, but when it is properly ripened and the other operations in the process of manufacturing cheese are rightly carried out, the undesirable organisms are overcome. As the acidity in the milk and whey develops through the action of the lactic acid-producing bacteria, the other kinds of germs disappear, unless the milk is very badly contaminated. When the milk is suspected to be of doubtful purity, it should be got more acid than usual by the addition of an increased proportion of starter. Too much starter is one cause of sour-flavoured cheese, but this type of cheese is preferable to one that is of an obnoxious flavour.

(134) Putrid Patches in Cheese.

Sometimes when a cheese is cut open it is found to have putrefied in one or more places, and this is

generally due to the presence of obnoxious bacteria and to the process of manufacture being at fault. When the curd is first cut it is important that the cubes be uniform in size. When the curd is not carefully cut, the small pieces will have drained sufficiently when the few larger pieces will contain a lot of whey. Later, when the cheese is made up, the whey retained in the large pieces of curd ferments, turning the cheese bad in that particular part. The remedy is to cut the curd to cubes of uniform size, and break by hand any pieces that have been missed by the knife. A small portion of milk from a cow with an inflamed udder, if mixed with that for cheese, will often cause the finished product to develop these patches.

(135) Misshapen Cheese.

In order that a cheese may be of a good shape, the freshly-ground curd, when put to press, must be levelled over, the cloth spread evenly on the curd, and the followers set squarely. The shape of a cheese is sometimes spoiled by careless pressing. A cheese which is well pressed, however, may afterwards get out of its proper shape. This may be due to the curd being either too acid or too sweet. An over-acid cheese sinks in at the top and bottom, giving it a concave appearance. This is also due to the cheese not being sufficiently pressed, and consequently containing too much sour whey, which increases in acidity after the cheese has left the press. A cheese which bulges out and assumes a convex appearance, except on the end next to the

shelf (which remains flat owing to the cheese standing on a flat surface), is the result of the curd being too sweet when vatted. The effect is chiefly due to the cheese containing an excess of moisture. However much within reason a cheese is pressed, the superfluous whey cannot be expelled if the cheese is too sweet. If a lot of pressure is applied to too sweet a curd, wet curd will be forced out through the small holes in the mould, instead of the surplus moisture. Another type of misshapen cheese is one which heaves and swells when in the ripening-room. The cause of this trouble is the curd being badly contaminated with the species of bacteria which produces gas. When a cheese shows signs of swelling it should be stabbed with a long needle or skewer to allow the gas to escape, otherwise it will probably burst open. Cheeses which are lightly pressed or unpressed such as Stiltons and Wensleydales, often get out of shape without the cheese becoming inferior in quality, but the better the appearance of a cheese the better it usually sells. Before pressed chesses are put to press the curd should be of the right consistency, and contain the correct percentage of acidity.

(136) **Cracked Cheese.**

Cheeses made from partly skimmed milk, or milk of poor quality, often crack when in the ripening room. Scalding the curd to too high a temperature has a tendency to make the cheese crack. The want of grease on the coat of a cheese will also make it crack. Freshly-made cheeses, especially those containing a fairly high percentage of moisture or those which

have been pressed too hard at first, leaving the interior too full of moisture, will often crack if exposed to a draught. This causes the exposed part of the cheese to dry too quickly.

(137) **Hard, Dry Cheese.**

This kind of cheese may be due to the milk being of very poor quality, or to an excessive amount of fat being lost in the process of manufacture. The *chief causes of an undue loss of fat*, and consequently of a hard-pressed cheese, are (*a*) renneting at too low a temperature, (*b*) the use of insufficient rennet, (*c*) cutting the curd too soon or carelessly, (*d*) vatting the curd at too high a temperature, (*e*) applying the pressure too soon. These and other factors cause a lot of fat to be lost, and the whey to be too rich in fat. The less fat a cheese contains the less moisture will it also contain, and it is chiefly the fat and moisture that makes the ripened cheese rich and mellow. The employment of too much rennet and the adoption of too high temperatures, also the development of too much acidity, will cause the curd, and later the cheese, to become too dry. These factors cause the curd to contract and expel its moisture too quickly. Ripening cheeses at too high a temperature will also make them hard and dry, as it causes them to evaporate unduly. Too much rennet and too high a temperature at renneting will cause a cheese to be of a chalky consistence.

(138) **Discoloured Cheese.**

The colour of cheese, except the blue-veined varieties, should be even throughout, whether the

cheese is a coloured one or not. In the case of artificially coloured cheese, an uneven or discoloured cheese is caused by the use of inferior colouring matter, or by adding it too near to the time of renneting, so that the curd begins to form before the colouring matter is thoroughly distributed throughout the milk. Another cause of a discoloured cheese is the milk being contaminated with bacteria which produce gas in the cheese. The gas causes the cheese to become bleached in the parts where it forms.

(139) **Sour Cheese.**

The chief cause of a sour cheese, which is usually a dry one also, is using over-ripe milk, often the result of not sufficiently cooling the night's milk in hot weather. Sometimes it is caused by the employment of too much starter. When over-ripe milk has to be made into cheese, the process of manufacture must be hurried on quickly to keep pace with the acidity which is developing very fast. In dealing with acid milk, do not start heating it until all the morning's milk is in the vat, then heat it up to the renneting temperature as quickly as possible. Rennet at a higher temperature than for normal milk, and use more rennet. The curd will soon be ready for cutting, and should be cut very fine so that it will drain quickly. Scald the curd to a higher temperature, and a little quicker than usual, then draw off the whey without pitching the curd. When ripening the curd keep turning it to cool it, and apply weights to assist in expelling the whey. Grind the curd when it is dry enough and vat when at a temperature of

70 deg. F. The curd should be firm, and if still too acid when put to press apply more pressure at first, and increase it at a quicker rate than usual. When over-acid milk is judiciously manipulated, fairly good cheese can be made from it, but if the cheese is not made quickly it will be hard and sour. The excess of acid in the cheese causes undue loss of moisture.

(140) Weak, Open-bodied Cheese.

This type of cheese is due to insufficient acidity throughout the process of manufacture. The chief cause is to have the milk too sweet to commence with. Milk for cheese should not be renneted until it is ripe, and ripening can be accelerated by the use of starter. On a cold day, when the acidity naturally develops slowly, use more starter, and vice versa. The use of too little rennet and too low a setting temperature will produce a weak curd and a weak cheese. When the acidity is found to be developing slowly the dairy doors and windows should be kept shut to keep the room as warm as possible, and maintain the whey at as high a temperature as possible without proving injurious to the kind of cheese being made. The warmer the whey is kept within reason the quicker will the acidity develop in it.

Do not remove the curd from the whey until it is sufficiently acid, as the acidity develops faster in the whey, which contains a lot of milk sugar, than in the curd. After drawing the whey, keep the curd from getting cold while it is ripening. It is a good plan

to ripen the curd on a rack placed in the vat on a cold day, or when the acidity is developing slowly. If warm water is kept in the vat jacket, the curd can be ripened at the more favourable temperature, which can be regulated as desired. When the acidity has been developing slowly throughout, do not apply much pressure to the cheese at first, and increase the pressure slowly, as a great deal of acidity will develop in the cheese if it is not too dry. In cold weather keep the press in a warm room, as, if the cheese gets chilled throughout, the development of acidity is checked.

Weak, open-bodied cheese generally contains too much moisture, as the moisture cannot be expressed unless the curd is acid enough. This type of cheese often ferments wrongly and ripens abnormally, as owing to the insufficiency of acidity, undesirable organisms rapidly develop.

(141) Mould Failing to Grow in Blue-veined Varieties of Cheese.

In order that the blue mould may grow in a cheese it must be slightly acid, moist, and of an open texture. Too much pressure applied to partly pressed cheese makes the texture too close so that the mould cannot grow in the cheese. If the curd is too sweet when vatted, the cheese ripens abnormally without the mould growing inside When the cheese are much too acid it becomes too dry for the mould to grow nicely. Having the ripening room too warm and too dry is also a cause of the mould failing to grow in the cheese.

(142) **Heated Cheese.**

When the temperature of the ripening room is much too high, and the cheeses get heated throughout the flavour and texture are spoiled. A heated cheese generally becomes greasy on the outside through fat escaping from it. One cause of rancid and hot flavoured cheese is ripening at too high a temperature.

CHAPTER XVII.

SOME VARIETIES OF BRITISH CHEESE—CHEDDAR.

There are a number of varieties of British cheese and they may be classified under the headings, Hard Pressed, Blue Veined, and Soft Cheese. The chief are as follows :—

Hard Pressed Cheese, including Cheddar, Dunlop, Cheshire, Leicester, Derby, Lancashire, Cleveland, Double Gloucester, Single Gloucester, Wiltshire.

Blue Veined Cheese: Stilton, Wensleydale, Cotherstone, Dorset Blue.

Soft Cheese: Colwick or Slipcote, Cream,, York or Cambridge, Lactic Acid.

CHEDDAR CHEESE.

There are several methods of making this kind of cheese, the following being the one generally adopted. The evening's milk is poured into the cheese vat through a milk filter, and cooled to 65 deg. F., when the nights are warm; at other times it will cool sufficiently of its own accord. The next morning skim off the cream and add to the milk ¼ to 2 per cent. of starter, unless the milk is very acid. It is not essential to use starter in the manufacture of any

variety of cheese as in very many instances better flavoured cheese is produced without it.

It has become a pretty general practice however to employ starter as the resulting cheese is of a more uniform character.

Starter is necessary where milk from several sources is collected and made into cheese as at a factory. If the night has been cold and there is only .18 per cent. of acidity in the milk, add 2 per cent. of starter, and decrease this proportion if the acidity of the night's milk is higher. Commence warming the milk in the vat, add the fresh morning's milk and the cream which has been warmed, then regulate the whole to a temperature of 84 deg. F. In early spring and late autumn adopt a slightly higher renneting temperature.

(143) **Renneting.**

When the milk is at the right temperature and and shows .21 to .22 per cent of acidity, or a 22 second rennet test, add the rennet in the proportion of one drachm to every three gallons of milk. Dilute the rennet with cold water, stir it deeply into the milk for three to five minutes, skim over the surface till the milk shows signs of coagulating, then cover the vat with the lid till the curd is cut.

If the milk is ripe, regulated to the right temperature, and inoculated with the correct amount of rennet, a curd of the proper character will form and be ready for cutting in forty-five to sixty minutes. It is, however, necessary, to increase the proportion of rennet if the milk is over-ripe, and at the latter part of the season when the milk becomes richer.

(144) **Cutting.**

When the curd is ready, cut it both lengthways and crossways with the vertical knife, then both ways with the horizontal knife. If the milk is over acid, cut again with the horizontal knife. The smaller the curd cubes the quicker they drain, and this is necessary with acid or " fast-working " milk. Clean any curd off the bottom and sides of the vat with the hand then commence to scald, being careful to raise the temperature slowly at first, at the rate of one degree in three minutes, and keep the curd gently stirred all the time.

(145) **Scalding.**

Raise the temperature of the contents of the vat to 98 or 100 deg. F., and get the curd to the condition known as shotty—that is, springy to the touch, and so that it does not smear if a handful is rubbed between the fingers.

Always scald higher with an acid or rich milk, and lower with a sweet milk. At the time of cutting there should be .14 or .15 per cent. of acid in the whey, and during the scald this will increase to the extent of about .03 per cent. The curd is now allowed to pitch or settle in the whey until it contains .19 or .20 per cent. of acidity, then the whey is drawn off and the curd ripened. With acid or fast-working milk, there is usually sufficient acid at the end of the scald for the curd to be drawn off without the curd being pitched. The manner in which the curd is ripened depends upon the amount. In the case of a

small quantity of milk the curd is consolidated in the vat by placing a rack and weight on it for about five minutes; the rack is then removed and the whey run off. The curd is then ripened in the vat. In the case of a large quantity of milk, the curd obtained, when ready to leave the whey, is put on the drainer or cooler, when most of the whey has drained away from the vat. In a short time the curd will then go together in a more or less consolidated mass. The ripening of the curd in each case is effected by cutting it into 9 in. blocks, which are then piled in layers three deep. Turn the blocks of curd, and repack them every fifteen minutes or so until when tested with the hot iron, $1\frac{3}{4}$-in. fine threads can be drawn; then the curd is ready for milling.

Good Cheddar curd, when ripe, contains only about 40 per cent. of moisture, is tough, pliable, and will "leaf"—that is, when pulled apart, will appear to be made up of fine layers. It will also emit a nutty odour, which although not easily described, is well-known to the cheesemaker. On testing the whey from the curd it should contain .9 per cent. of acidity. It is necessary to get the curd properly ripened, as if wrong at this stage any after treatment will not remedy it. The ripened curd is put through the mill, or grinder, then spread out over the cooler to mellow and cool.

(146) Salting.

Salt the curd at the rate of one ounce to every three pounds of curd, and turn it over to mix the salt evenly. With a large quantity of milk, the weight

of curd is estimated. Always increase the proportion of salt if the curd is too wet.

If the curd is at all tainted, leave it on the cooler as long as possible, and aerate it by keeping it well stirred, also add more salt. Vat or put the curd into moulds when its temperature has fallen to 70 deg. F., and not before, otherwise much fat will be lost at the time of pressing. Do not let the curd get too cold, or it will not go together properly in the press. Line the moulds with coarse cloths, and pack the curd into them, fill the moulds up level, then place the followers on, and put the cheese under the press.

The whole process should be completed in six to eight hours.

(147) **Pressing.**

The pressure must be applied gradually. For the first hour apply 1½ or 2 cwt. only, then gradually increase it so that in about two hours' time the cheese is under a pressure of 10 cwt. At night the cheese is turned and put under a pressure of 15 to 20 cwt. for the night. The next morning bathe the cheese in water at 120 to 130 deg. F. for a couple of minutes or so, in order to make firm and improve the coat, but this is not absolutely necessary in order to produce prime cheese.

Put the cheese in a fine cloth, return it to the press under 25 cwt. The next morning turn the cheese, grease and cap one end, then press with 25 to 30 cwt. On the fourth day grease and cap the other end of the cheese and press it again six hours or so. When pressed, bind the cheese tightly with a

stout calico bandage about 3 in. or 4 in. wide, then take it to the curing-room.

Cheddar cheese is best ripened at a temperature of about 60 to 65 deg. F., but on no account above 70 deg. F., or the very best cheese will be spoilt both in flavour and texture.

A full-sized Cheddar cheese weighs 90 lbs. to 100 lbs., and takes six to nine months to ripen, but many cheeses are sold at three months old. Truckle Cheddars weigh 12 lbs. to 14 lbs. each, and lose more weight in ripening than do the full-sized cheese.

(148) **Acidities.**

Milk at renneting, .21-.22 per cent.; whey at cutting, .14-.15 per cent.; drawing whey, .19-.20 per cent.; vatting, .85-.90 per cent.; next morning, .95-1.1 per cent.; one week after, 1.3 per cent.

CHAPTER XVIII.

CHESHIRE CHEESE.

There are three types of Cheshire cheese which is made either coloured or uncoloured according to market requirements.

(149) Early Ripening Cheese

is made at the beginning of the season to the end of April, or the second week in May. It contains a fairly high percentage of moisture, and is ripe in two to six weeks. This type of cheese should be sold as soon as it is ready, as if kept much longer than six weeks it becomes acid, dry, bitter in flavour, and deteriorates generally. In its manufacture mixed milk is employed. The evening's milk is left in the vat, and partially cooled, if necessary. The following morning the cream is skimmed off and warmed up. About ¼ per cent. of starter is added to the freshly-skimmed milk, which is then warmed. The cream and morning's milk are added and the whole is regulated to a temperature of 82 to 84 deg. F, and renneted at the rate of 1 drachm to 2 or 2½ gallons of milk, when it shows a twenty-four second rennet test. If a coloured cheese is made, and this is general in

the early part of the season as milk is then very white, annatto is thoroughly mixed with the milk in the proportion of about 1 drachm to five gallons of milk ten minutes before renneting. In thirty to forty-five minutes the curd is cut once each way, then carefully stirrred for about fifteen minutes, during which time it is scalded to two or three degrees above the renneting temperature. Pitch the curd until ¼ in. fine threads can be drawn on the hot iron, then run the whey off and put the curd on the cooler. Cut the curd into blocks and turn them every ten minutes or so for about half-an-hour until 1¼ in. threads can be drawn by the hot iron test. Next grind the curd, and salt at the rate of 1 oz. to 3 lbs. of curd, which is ground rather small in order to give the cheese the desired texture. The curd is vatted and placed in a cheese oven, or in a room by the side of a fire, where the temperature is kept uniform at about 76 deg. F. In the evening turn the cheese and put it back in the oven until the next morning. The cheese oven consists of a chamber built in the wall near a fire, so that it can be kept heated at a suitable temperature by a flue passing under the oven. When taken from the oven the cheese is put under the press for four or five days, with only a slight pressure, about the weight of the screw applied. The cheese is pressed until moisture no longer escapes from it while under pressure. When pressed a bandage is pasted on the cheese, and is kept in a warm room for about two weeks, and then taken to the ripening room if not sold at this stage.

(150) **Medium Ripening.**

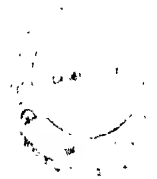
This variety is usually made during May, June and again in September. It is ripe in six to twelve weeks, and has better keeping properties than the quick ripening variety of Cheshire cheese. The main differences in the process of manufacture from that already described are:—The milk is renneted with 1 drachm to every 2½ gallons of milk, which is regulated to a temperature of 86 to 88 deg. F., and is considered ripe when it gives a 28 second rennet test. When a coloured cheese is made the annatto is added at the rate of 1 drachm to 5 or 6 gallons of milk. The period of coagulation is about an hour then the curd is cut gently lengthways, and left ten minutes for the whey to rise. Then cut crossways and leave for about five minutes, and cut both ways again. Stir the curd for about ten minutes, then scald it slowly to 88 or 90 deg. F. After scalding pitch the curd for half an hour, then roll it to one end of the vat and draw the whey off. Put the curd on the cooler, cut it into blocks, turn them five or six times at intervals of ten minutes, and grind when ½-in. threads can be drawn. Salt at the rate of 1 oz. to every 2½ lbs. of curd, then vat, and put the cheese in the oven. The next day press with ½ cwt., gradually increase this to 1 cwt., and in four or five days' time the cheese will be ready to leave the press. Keep the cheese in a warm room for two days, then ripen at 60 deg. F.

(151) **Long Keeping Cheese.**

This type is made during July and August, and although it ripens in about three months, it will keep

in good condition for twelve months. The manufacture is altered slightly from that of the medium ripening, so as to prolong the ripening period. The night's milk is cooled so that it will not develop much acidity during the night. The milk is renneted at 88 to 90 deg. F. at the rate of 1 drachm of rennet to every 2½ gallons of milk. The curd is cut to about the size of small peas, and scalded to 90 to 92 deg. F., then stirred until it is shotty. Salt is added in the proportion of 1 oz. to 2 lbs. of curd. After taken from the oven the cheese is pressed with a little more pressure than the medium ripening cheese. The best temperature at which to ripen this type of cheese is 55 deg. F.

The difference in the curds when ripe and ready for grinding are: *Early ripening:* Wet, soft, velvety to the touch, and slightly acid. *Medium ripening:* Firm, slightly leathery, acid. *Slow ripening:* Fairly dry, leathery consistence, very acid.



CHAPTER XIX.

(152) LEICESTER CHEESE.

Leicester cheese is made from mixed milk, which is treated up to the ripening stage in the same way as for the manufacture of other kinds of cheese. The milk when ripe must not contain more than 0.2 per cent. of acidity, or show a shorter rennet test than 23 to 24 seconds. The ripening of the milk is assisted by the addition of a pint or slightly more starter to 40 gallons of milk, which quantity is sufficient to make one cheese. Regulate the milk to the renneting temperature of 84 deg. F., and when ripe, add the rennet. This variety of cheese is coloured, and the annatto added at the rate of 1 drachm to every 4 gallons of milk, must be mixed with the milk ten minutes before renneting, so as to get a thorough distribution of the colouring matter prior to the coagulation of the milk taking place. Unless the annatto is evenly distributed throughout the milk before the curd commences to form, discoloured cheese will result. The proportion of rennet employed is 1½ to 1¾ ozs. to 40 gallons of milk, and after being diluted the rennet is stirred in the milk in the usual way. In three quarters of an hour's time the curd should be sufficiently firm for cutting into small pieces by means of the vertical and horizontal knives. Stir the curd

for a few minutes and remove any that is adhering to the sides and bottom of the vat, then cut once again with the horizontal knife. An acid test of the whey should show it to contain 0.12 or 0.13 per cent. of acid. Now stir the curd in the whey and scald it slowly to a temperature of 90 deg. F. Continue the stirring until the curd is firm enough for the small pieces not to stick together when a number of them are pressed in the hand. The curd is then pitched until $\frac{1}{8}$ in. fine threads may be drawn from it with the hot iron, then the whey is drawn off and the curd in granular form put on the cooler. Stir the curd for about a quarter of an hour, then cover it with cloths. When matted together, which process is sometimes assisted by the addition of a few small weights, cut into cubes about four inches in size, and turn them every twenty minutes. When $\frac{3}{4}$ in. fine threads can be drawn by the hot iron, the curd is ground into small pieces by being put twice through the grinding mill, then salted with 1 oz. of salt to every 4 lbs. of curd. Be careful to have the salt thoroughly mixed to the curd, then when its temperature is about 70 deg. F., the curd is vatted. The moulds used for Leicester cheese are 18 in. in diameter by 6 in. deep. As soon as the moulds have been filled they are put in the press, and for the first hour only the weight of the screw is applied. The pressure is gradually increased to 5 or 6 cwt. in the evening when the cheese is turned into a coarse cloth, and put under a pressure of 12 to 15 cwt. for the night. The following morning turn the cheese, put them into fine cloths, and under a pressure of

15 to 18 cwt. The next day grease and cap the cheese, put them in the press for two or three hours, then bandage and take them to the ripening room. The cheese are ready for selling in from three to six weeks. The yield of cheese may be taken as an average of 1 lb. to a gallon of milk, but towards the latter part of the season, when the milk increases in quality, the yield of cheese would be higher. A full sized Leicester cheese weighs from 38 to 42 lbs.

CHAPTER XX.

(153) DERBY CHEESE.

Derby Cheese may be made coloured or uncoloured. In the Midland districts it is not usual to colour it. It is flat-shaped, similar to Leicester, and weight about 30 lbs. when ripe.

It is made from mixed milk. The evening's milk is strained into the cheese vat and cooled to a temperature not higher than 75 deg. F. By morning the temperature will probably have fallen to 65 deg. or lower, depending chiefly on the temperature of the cheese room. The following morning skim off the cream, add the fresh milk and starter, then commence to heat up the whole. The proportion of starter used will need to be varied according to the season. In the colder months up to 2 per cent. is added, but in the summer this is reduced to 1 per cent.

Strain the starter through a muslin cloth to prevent any lumps getting into the milk, and return to the vat the cream (which has been warmed to 100 deg. F.). The temperature of the milk is raised to 84 deg. F. in summer, and 86 deg. F. in winter. If a coloured cheese is required, add the annatto colouring at least ten minutes before the rennet at the rate of 1 drachm to every 6 gallons of milk. When the

milk shows a rennet test of 21 to 22 seconds the rennet may be added at the rate of 1 drachm to 2½ gallons of milk. The rennet should be diluted with three times its volume of cold water. Stir in the rennet thoroughly for five or six minutes, then top stir until the milk shows signs of coagulating, which it does usually in fifteen minutes from the time of renneting. Cover over the vat to prevent draughts from causing the temperature to fall too much during coagulation, as if this happens there results an excessive lot of fat from the curd.

In forty-five minutes' time the curd should be sufficiently firm to cut. Cut lengthways and crossways with the vertical knife and lengthways only with the horizontal knife. At this stage an acid test of the whey should show it to contain from .12 to .13 per cent. of acidity.

Clean down the sides of the vat and commence stirring very gently for ten minutes, or until the curd floats freely, and can be stirred easily without bruising.

Now commence to raise the temperature very slowly, at first at the rate of 1 deg. F. in three minutes up to the final temperature of 96 deg. F. This usually takes from forty-five to fifty minutes.

Continue stirring after the temperature is attained, until the curd feels fairly firm, and the particles have become quite rounded in shape, or if a small cube is taken between the thumb and finger it will, with slight pressure, "just burst." The acidity of the whey at this stage should be .15 per cent.

The curd is now allowed to settle until it will draw

from ⅛ to ¼-in. threads on the hot iron, and the curd will also begin to leave the sides of the vat when the whey is ready to draw.

Draw off the whey until it reaches about two inches below the surface of the curd, then quickly scoop out on to the cooler, keeping the curd well stirred. If the cheese is not too acid (.19 per cent.) and the amount of moisture in the curd is correct, it will have a soft velvet-like feeling and a jelly-like appearance. The jelly-like appearance is the chief characteristic of a Derby curd.

Cover over the curd with cloths and leave for the acidity to develop. At the end of twenty minutes open out the curd and cut across the centre, folding one half over the other.

Second Turn.—Cut into blocks about 9 inches by 18 inches lengthwise, and reverse the position of the curd, making the outside edges come to the inside.

Third Turn.—Pile the blocks three deep, reversing the position of each block.

By this time the curd should be in a fit condition to grind, *i.e.*, when it will draw from ⅛ in. to ¾ in. threads on the iron or show an acidity of .38 per cent. to .4 per cent. The curd should have a fair amount of moisture yet not appear wet, be quite pliable or springy to the touch, and show distinct signs of flakiness when pulled apart. Grind the curd in the same way as Cheddar only rather larger.

Mix the salt in proportion of 1 oz. to 3 gallons of milk. Continue to mix well until the temperature is reduced to 70 deg., otherwise much fat will be lost during the time in press.

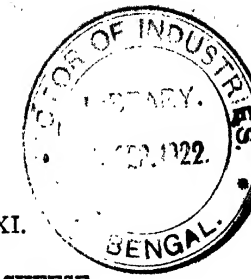
Vat into moulds lined with coarse cloths and put to press immediately. The acidity of the whey from press should be between .5 per cent. to .55 per cent.

The weight of press is sufficient pressure until the evening, when it must be turned into a dry cloth and returned to press with 5 cwt. additional pressure.

The following morning turn again and cap both ends of the cheese with grease and muslin, return to press, increasing the pressure up to 15 cwt.

Next day bandage with strong calico pasted on with cold flour paste. Convey to a ripening room with a temperature of 65 deg. and turn every day for the first four weeks. After this, three times weekly will be sufficient.

Derby cheese are fully ripened in six to eight weeks but are ready and may be sold in three to four weeks after making.



CHAPTER XXI.

154) CAERPHILLY CHEESE.

Caerphilly cheese is chiefly made from mixed milk. The evening's milk is filtered into the vat, and cooled when necessary, in order to prevent too much acidity developing during the night. In the morning skim off the cream, add to the milk about ½ per cent. of good starter, mix in the morning's milk and the cream which has been warmed up, and heat the lot to 86 deg. F. When the milk contains .18 per cent. of acidity, add to it 1 dram of rennet extract to every three gallons of milk, diluting the rennet as usual before adding. In about forty-five minutes after renneting the curd will be ready for cutting, both ways with the vertical knife and lengthways only with the horizontal knife. Three minutes should elapse between each two cuttings. At this stage there should be about .13 per cent. of acidity in the whey. After cutting the curd, leave it for ten minutes, then stir it gently for about twenty to thirty minutes, during which time the contents of the vat are gradually raised to a temperature of 88 deg. F. When the scalding is completed, and .16 per cent. of acidity is present in the whey, draw it off, and scoop the curd into coarse cloths, or leave it in the vat to drain. Half an hour after drawing the

whey the curd is cut into three inch cubes, and piled in the vat, or tied up in the cloths, and allowed to drain for another half-hour.

Now carefully break the curd up into small pieces, and after adding salt at the rate of 1 oz. to every 3 lbs. of curd and mixing well with the curd, put it into the moulds, which have previously been lined with cloths. From 9 to 11 lbs. of curd is usually put into each mould. When vatted, .4 per cent. of acid should be present in the whey. Two hours after filling the moulds they are put under the press, and the weight of the screw applied. In three hours' time turn the cheese, put it under a pressure of 3 to 5 cwt. until the next morning, then take the cheese out, turn into a fresh cloth and put back to press. In the afternoon salt the cheeses again in the same manner, and press them with 15 cwt. pressure during the night. Take the cheeses from the press, wipe them with a damp cloth, and take them to the ripening room. When in the ripening room wipe over once or twice each week with a cloth wrung out in brine. This helps to dry the cheese and improve the coat. Caerphilly cheeses are best ripened at a temperature of 65 deg. F., and take three or four weeks to ripen.

Alternative methods of salting are (1) brining; (2) applying the salt to the coating of the cheese.

In the case of brining, the cheese are immersed in a strong solution of salt and left in for three days, after which they are allowed to dry, and then removed to the ripening room.

The disadvantage of this method is that where a

large number of cheeses are made, very large brine storage tanks are required,

In the case of salting the cheese externally no salt is added to the curd at the time of grinding, but on the first morning when taken out of press ¼ lb. of salt is carefully rubbed into the coat of each cheese. The cheese is then returned to the press.

CHAPTER XXII.

(155) STILTON CHEESE.

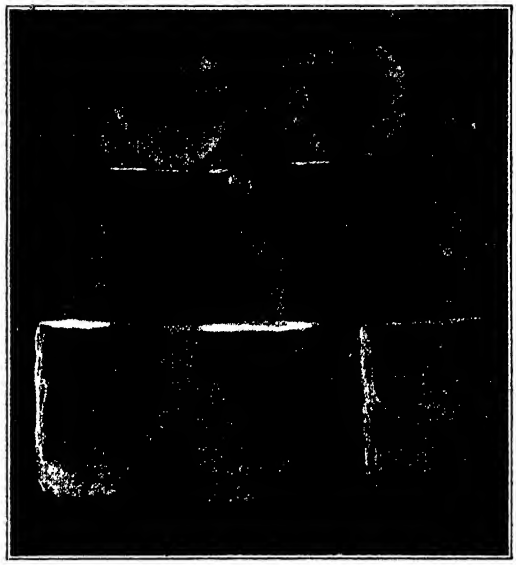
Stilton, the most important variety of blue moulded cheese, is supposed to have derived its name from a village of that name situate in Huntingdonshire. Leicestershire is probably the chief county of its manufacture, though it is also made to some considerable extent in Nottinghamshire, Staffordshire and Derbyshire.

Stilton, unlike most other firm-bodied cheese receives no pressure during manufacture.

Its production used to be common on most dairy farms in the above areas, both large and small, but the growth of milk selling has caused a reduction in manufacture, although now it is made at some factories, and on large farms additional milk is often purchased and converted into cheese.

In many cases the cheese is sold fresh, *i.e.*, about a month old, and small makers, often sell to large makers, who in their turn sell to dealers in the autumn, although to some extent, the cheese is sold and eaten fresh, and not kept to ripen fully and go blue-moulded.

The public demand for ripe blue Stilton cheese occurs chiefly about Christmas time—hence it is usually produced and marketed for this season.



STILTON CHEESE.
One cut through, showing blue mould.

In the production of Stilton cheese it is essential that the best milk should be used, and if the cheese is required to become blue-moulded and have the best flavour, it must be made from the milk of cows which are out on good pastures; thus the manufacture of Stilton cheese begins usually in April and goes on till the end of September, or early in October. It is always thought that certain kinds of land and particular herbage produces the best flavoured cheese.

Utensils for Stilton Cheese-Making.

Tin Setting Pans gauged from fifteen to thirty-two gallons, sufficiently large to hold milk for making two cheese.

Coolers or Sinks, otherwise draining troughs, for holding the bundles of curd: these are chiefly made of tin or tinned iron, but sometimes of earthenware. Each should be fitted with a plug for the removal of the whey, and have a loose perforated tin tray or wooden rack in the bottom.

Tin Hand Bowls or Scoops for ladling the curd into cloths on the cooler, or sink. The bowls must have sharp edges so as to cut the curd clean.

Tin Moulds or Hoops measuring twelve inches by eight inches in diameter. The moulds are open-ended.

Tin Ring Extensions for Moulds.

Wood Stands for Moulds.

Straining Cloths, thirty-six inches to forty inches square.

Calico for bandages and the usual other accessories required in cheesemaking.

DRAINING SHELVES with grooves to collect and carry off the whey.

The Cheese is made on two systems:—

(1) From one curd.

(2) From two curds, *i.e.*, two different lots of curd mixed together, one being made from morning and the other from the evening milk.

As a general rule Stiltons are made on the one-curd system now, although many makers still maintain that better cheese is produced where two different curds are mixed. The chief objection to the two-curd system is, that when the ripe cheese is cut it is apt to be uneven in colour, and in hot weather—in waiting for the evening milk's curd—the morning's milk curd frequently becomes too acid.

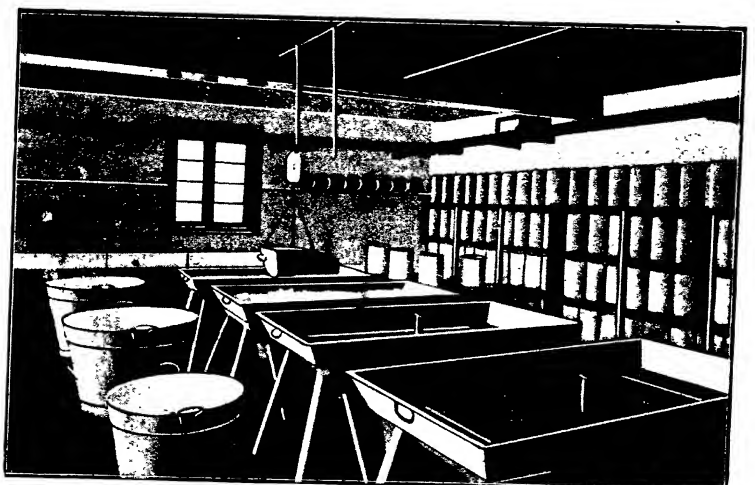
The advantage of the two-curd system is, that it helps to ensure favourable conditions for the development of blue mould, as the curds do not readily mat together, and it leaves a sufficiency of air enclosed in the cheese to encourage the growth of blue mould.

The One Curd System.

The milk as milked should be brought from the cow shed as soon as possible, before it has lost its natural heat, and carefully strained into the setting tub.

According to the size of cheese being made, which varies somewhat, some fourteen to sixteen gallons of milk are required to make one cheese. (Setting tubs hold sufficient to make two cheese, the full sized Stilton taking sixteen gallons to produce).

The temperature should be regulated from 80 deg. F. to 86 deg. F. according to the time of year,



STILTON DAIRY.

Showing setting pans, coolers or sinks, and moulds (containing cheeses) on draining shelves

the higher temperature being used when the weather is colder.

It is a strongly ingrained idea amongst Stilton cheesemakers that the best Stilton cheese can only be produced where home-made rennet is used, and a good many makers still prefer to make and use their own rennet rather than employ commercial extracts. Undoubtedly a certain amount of prejudice has been created against the use of rennet extracts because they have been injudiciously employed. It should be realised that they are about ten times as strong as home-made rennet—hence the quantity used must be proportionately reduced. Where this is not done, curd too firm for Stilton cheese is produced. A little preservative added to home-made rennet is advisable, as this rennet rapidly decomposes and usually becomes objectionable during a very short space of time in hot weather. If extract of rennet is used, about one dram to every five gallons of milk is the quantity to employ, and this should be well diluted with cold water before being added to the milk.

Stir in the rennet for quite six minutes, so as to prevent the cream from rising to the surface of the milk, and keep the surface moving slightly until coagulation commences.

The milk will show signs of coagulating in about twelve to fourteen minutes, and be completed in about an hour and a half. The usual test for readiness of curd for cutting should be applied, though the curd when ready for ladling out will be softer than the curd which is to be cut into cubes, as required in the manufacture of other varieties of cheese.

The curd is ladled out into coolers or sinks lined with coarse cheese cloths thirty-six to forty inches which are held in position by strips of wood placed square, across the cooler. The curd is transferred from the setting pans into the cloths by means of a tin hand bowl. It must be taken out in fairly thick slices, and about three-and-a-half gallons of curd added to each cloth.

The curd is left in the cloths, which are just folded over, for one and a half hours after ladling, the plug being left in the cooler so that the curd is practically floating in whey all the time.

At the period of ladling out, the acidity of the whey is usually .11 to .12 per cent.

The cloths are now tied across to draw the curd together and to help to commence the expulsion of whey, and the first lot of whey is let off from the cooler at this stage.

The method of tying the cloth is to take three corners and bind round with the fourth, and at the first tying this is done loosely.

The plug is now put back in the cooler and the bags of curd left for thirty to forty minutes, during which time a further lot of whey from the curd will collect in the cooler. The second drawing of whey can now take place and the bags of curd be tightened.

The length of time in which the curd should remain in the first and second lots of whey will vary according to the degree of firmness the curd has attained and its acidity. If the curd is very soft it is not advisable to drain off the whey too quickly. After

STILTON CHEESEMAKING
Cooler showing curd ladled out into cloths

STILTON CHEESEMAKING.

Showing method of tying bundles of curd in cloth. Three corners of cloth are bound round with the fourth

letting off the second lot of whey, the plug is left out of the cooler and cloths tightened at intervals of one and a half hours, on four or more occasions, depending upon the consistency of the curd.

The total number of tightenings of the cloths will thus be six, or sometimes eight are necessary, according to the way in which the acidity and condition of the curd are developing. The curd is ready to turn out of the cloths when it contains .18 per cent. of acid.

The bundles of curd may be piled one on top of another to force out more moisture if the curd is not becoming firm sufficiently rapidly.

This piling of bundles of curd should occupy the period following the last tightening of the cloths. The curd is now turned out of the cloths on to the cooler, or curd sink, and then cut up into cubes of about three inches, turned, and allowed to drain further and increase in acidity.

It should be subsequently turned every half-hour and it must be kept apart by being cut up into cubes until the curd matures and the acidity reaches .4 to .5 per cent. when it is ready for breaking. It usually takes from two to four hours from the time it is turned out of the cloths till it is ready for breaking and salting.

The curd at this stage should be fairly solid but be quite tender and moist, and if torn apart should show a nice flaky condition.

The following gives in tabulated form approximately the details of manufacture, where making cheese on the *One-curd system*, showing respectively separate lots of cheese made.

(*a*) in the morning, from morning's milk.

(*b*) at night, from evening's milk.

(*a*) *Set in the morning.*	a.m.
Time of rennetting ..	8.0
Time curd ladled into cloths (acidity. 11 to. 12 per cent.)	9.30
Time cloths tied first and whey let off (plug being then re-inserted in sink, or drainer)	11.0
Time cloths tightened and second lot of whey let off. (acidity .2 per cent.) (Plug is now left out of sink, so as to allow of free drainage)	11.30
	p.m.
Time third tie	1.0
Time fourth tie	2 30
Time fifth tie	4.0
Time curd turned out of cloths on to cooler (or sink) and cut up ..	5.30
Time cut and turned again	6.0
The process is repeated at half-hourly intervals until the curd is sufficiently firm and acid enough for breaking, salting, and putting into moulds The acidity when the curd is ready to be broken by hand, and salted, should be from .4 to .5 per cent.	
Time of finishing, about	9.0

(*b*) *Set at night.*	p.m.
Time of renneting ..	6.0
Time of ladling (acidity .11 to .12 per cent.) ..	7.30
Time first whey let off (plug re-inserted in sink)	8.30
Time cloths tightened and second lot of whey let off (acidity .2 per cent. and plug now left out of sink)	9.30
Time again tied, when curd is left in the cloths on the drainer overnight	10.0
	a.m.
Time next morning when cloths again next tied	6.0
Time next tied	6 30
Time turned out on to cooler or sink and cut up	7.0
Cut and turned subsequently every half-hour until curd ready for breaking, and salting, *i.e.*, when curd reaches proper condition and contains .4 to .5 per cent. of acidity	
Time of finishing about	9.0

Modified System of Manufacture.

The above system may be modified somewhat in practice, and where a large number of Stiltons are turned out daily, the length of the process is often somewhat curtailed. This may be done by adding a

small quantity of starter to the milk but very great care must be exercised, about half a dram of starter to the milk for each cheese usually being sufficient.

Instead of letting the whey off on two separate occasions, the curd after being ladled into the cloths may be left two hours, and then all the whey let off and the plug left out of the drainer, the cloths being lightly tied at the end of the first hour after ladling.

The bundles of curd are tightened twice again—or four times in all—and then piled one on top of another three high and the curd is turned out of the cloths on to the drainer four hours after draining off the whey. It is then cut and turned for about two hours longer, when it is broken, salted, and put into moulds.

In dealing with the evening's milk, after drawing off the whey, the curd is piled in bundles and left all night. The next morning it is turned out into the sink then broken up and salted. With this method of dealing with the milk, the total length of time occupied in the manufacture is about nine hours for the morning's milk and thirteen and-a-half for the evening's milk.

The Two Curd System of Manufacture.

The morning's milk is converted into cheese in a similar manner to that described in the *one-curd* system, the difference being that instead of finishing the operation, the curd, when turned out of the cloths, is cut into squares of about four inches, which are left in the draining sink overnight. A cheese cloth should be lightly thrown over the curd to

Scraping and Bandaging.

When the cheese shows signs of leaving the mould and presents a greasy appearance, it is taken out of the mould, and scraped with an ordinary table knife. This scraping is done with the object of giving the cheese a smooth surface and to fill up the cracks and crannies, which induce attacks from cheese flies, as it is in such small cracks and crannies that these flies lay their eggs. In scraping, the flat side of the knife should be used together with a little hot water to moisten the surface of the cheese. After scraping, a binder or bandage consisting of a piece of grey calico a little wider than the depth of the cheese—or long enough to allow an inch or so to overlap—is stretched tightly round the cheese and pinned on.

The mould is then replaced and the cheese put back on the shelf. This process is repeated on the day following, a fresh bandage put on, and the cheese turned. The hoop is kept on during this period to help the cheese to retain its shape. On the third day it is again bandaged and taken to the drying room. This should be a room where there is a good current of cool air, and where the temperature may be maintained at about 60 deg. F. On two separate days after the cheese have been put in the drying room, the bandage should be renewed.

Formation of Coat.

If properly treated in the draining and drying rooms, a nice crinkly coat will form on the cheese after it has been in the drying room from ten days

to a fortnight. The cheese should be crinkled all over and present a white appearance. The air of the drying room must be sufficiently moist, otherwise the coat of the cheese may become hard and crack. Cheese in the drying room should be turned each day on to a fresh board. If the cheese crack, it is necessary to cover them with a damp cloth. White crinkled patches first form on the cheese, which spread over the exterior surface until the coat fully forms. Unless cheese is scraped at the right period the crinkle on the surface will not be correct but either too large or too small. Too large crinkle is the result of scraping the cheese too late, and too fine a crinkle from scraping too early. Crinkle is due to evaporation and shrinkage in the cheese and to the growth of mould, etc., on the surface.

Ripening.

After a period of fourteen days the cheese may be removed to the ripening room, or cellar, which should have a temperature of about 60 deg. F. and the air be nice and humid. Under normal conditions it will take about four months for Stilton cheese to ripen, and they should be turned on the shelves each day. It is very necessary to see that the conditions prevail which are suitable for the growth of blue mould, on the development of which, under proper conditions, the fine flavour of Stilton cheese largely depends.

The loss in weight during the ripening of Stilton cheese is about 55 per cent.—*i.e.*, the difference in the weight of curd as put into the moulds compared

with the weight of ripe cheese yielded at the end of say, four months. The loss occurring at the different stages is approximately as follows :—23 per cent. on the draining shelves, *i.e.*, during the first six or seven days ; 10 per cent. in the drying room (or during the coating process) and about 22 per cent. subsequently in the ripening room.

The conditions essential to ensure the proper growth of blue mould are as follows :—

(1) The presence of the correct amount of acid and moisture in the cheese.

(2) A somewhat porous or open texture of the interior of the cheese which allows of a sufficiency of air for the growth of mould.

(3) Proper access of fresh air to the ripening room.

(4) Proper amount of humidity or moisture in the air. The amount of moisture in the air may be easily regulated, and it is desirable to have a hygrometer in the ripening room in order to indicate that the right amount of moisture is present in the air. When the air is too dry the floor should be kept damp and if this is not sufficient to make the air moist enough, wet cloths may be hung up in the room. If, on the other hand, the room is too moist more air should be admitted. Cheese which become too firm and dry may be stood on a cement floor and covered over with damp cloths, which will assist the development of blue mould.

Cheese of too close a texture may be improved by scraping, which consists of running a skewer into the cheese and thus making small holes for the admission of air, and this may be done when the cheese are a month old. The inoculation of blue mould into the cheese by means of skewering does not prove satisfactory, because if blue mould develops too quickly, *i.e.*, when it gets too much air, it does not form the enzymes which produce the fine flavour in cheese, but causes the cheese to taste objectionably mouldy.

The points of a prime Stilton cheese are as follows :

(1) It should possess a brown uniform crinkled exterior, which should " give " on pressure by the thumb.

(2) The cut surface should show up the veins of blue mould, which should be numerous and distinct from the curd, and they should be white and not yellow in appearance.

(3) The flavour should be rich and mellow, with no predominance of blue mould and there should be absence of an acid or pungent taste. The texture should be moist and creamy, and the cheese possess good keeping qualities.

There are many troubles experienced by the maker of Stilton cheese and reference may be made to " Faults and Defects " set out in earlier pages of this book.

The chief difficulties to which the Stilton maker is liable may be enumerated.

Slip Coat is a troublesome condition which fre-

quently arises and causes considerable waste. It occurs chiefly in damp close weather, and where cheese is made within a wide range of temperature. It is due to abnormal checks in the drainage of the cheese, caused by a sudden change in the temperature. Thus when the weather is warm the drainage proceeds at a rapid rate, but is suddenly checked by a very cold night, such as frequently occurs after a hot thundery day. When the drainage is checked, a hard coat forms on the outside and when warm weather again ensues the moisture from the interior of the cheese fails to escape through the hard coat and collects in a slimy mass just under the exterior surface. Another cause of slip coat is undoubtedly due to scraping the cheese too late. As prevention is better than cure, it is desirable to regulate the conditions so as to prevent slip-coat appearing, by arranging the circulation of plenty of fresh air round the cheese on the shelves. The only remedy that can be adopted is to scrape off the slimy coat and allow a fresh coat to form.

Soapy Cheese.—Soapiness is caused by having the cheese too sweet, or putting the curd together too sweet, and not promoting drainage by proper attention to the suitable temperatures. Cheese chilled too much, frequently prove sweet and soapy.

Chalky Cheese—A hard, dry condition of the cheese, which is chiefly caused by using an excess of rennet and getting the curd too acid. Not having sufficient moisture in the drying and ripening rooms also tends to promote the condition.

Mitey Cheese.—Mites attack Stilton Cheese to a considerable extent and often cause a tremendous wastage by causing the coats to crumble away.

The mites should be kept down by brushing the cheese attacked daily and sweeping up and burning the matter containing them. Scrub and scald the cheese shelves frequently.

Cheese very badly attacked may be dipped momentarily in scalding water and then well rubbed with flour before marketing.

Discoloured Cheese.—The curd of the cheese in this case assumes a yellow colour instead of remaining white. As the ripening process proceeds, the yellow colour becomes intensified and the cheese becomes soft and pasty in texture. Such cheese do not possess good keeping qualities and have generally to be sold at a reduced price, and often entail much loss.

The trouble is generally attributed to three causes, viz. :—

(1) Too much moisture in the curd when put into the hoops or moulds.

(2) Lack of sufficient acid in the curd at the time of salting.

(3) The addition of too little salt and the employment of salt of inferior quality.

It is commonly the case with all classes of cheese, that if too much whey is left in the curd and there is an insufficient amount of acidity developed, fermentations of an undesirable kind take place and the products of the growth of bacteria, or enzymes, produce inferior cheese.

CHAPTER XXIII.

(156) WENSLEYDALE CHEESE.

This is one of the blue-veined or blue moulded varieties, and is named after the Wensleydale district in Yorkshire, where it is chiefly made. There are two distinct varieties :

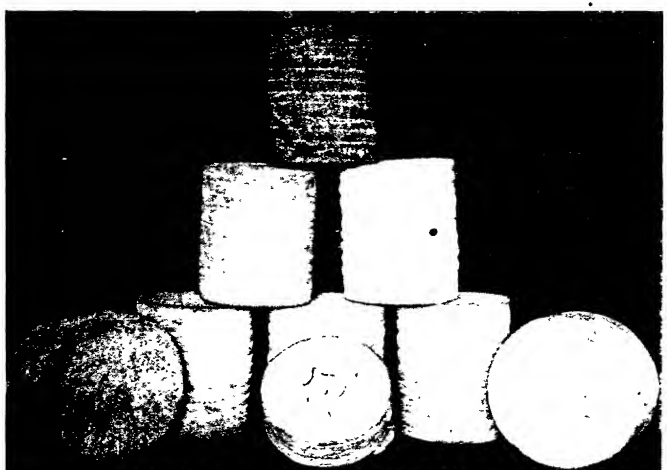
(1) The Stilton-shaped Wensleydale which goes blue moulded when ripe.

(2) The flat-shaped Wensleydale, which is white, is consumed fresh, and does not generally go blue moulded.

The flat-shaped variety is made chiefly during what is called the " off " cheesemaking season, which is the early part of the year and late in the season, whilst it is also made in many cases throughout the winter.

The Stilton-shaped Wensleydale is made in June to about the end of September or during the season of the year when the milk is most suitable for producing the best quality of cheese. The following description applies to both varieties :

Mixed milk is used and in hot weather the evening's milk is cooled to 65 deg. F. to prevent it becoming over-acid during the night. Next morning the cream is skimmed off, warmed up, and after the morning's



WENSLEYDALE CHEESE—FLAT AND SHILDON SHAPES
One cut through showing blue mould

milk has been added to the vat and the warming to renneting temperature commenced, the cream is returned to the vat and mixed in with the milk. It is advisable to have about .2 per cent. of acid present in the milk when the rennet is added.

If the milk is sweet rather more starter than usual is required, and as much as 3 to 4 per cent. is added to very sweet milk, but generally about 1 per cent. is used.

Add rennet at the rate of 1 drachm to every four gallons of milk.

In winter and early spring the renneting temperature should be 84° F. to 86° F., but in summer and autumn a temperature of 80° F. to 82° F. will give the best results.

After adding the rennet stir deeply for five minutes and afterwards on the surface to keep the cream from rising. Stop moving the milk as soon as it shows signs of coagulating. Coagulation is completed in fifty to sixty minutes, depending upon the acidity of the milk. The coagulation period is longer if the milk is sweet.

In case of very acid milk the curd may be ready to cut in twenty to thirty minutes.

It is best to cut the curd so soon as it is ready irrespective of the time taken in coagulating. If the curd is firm and will raise and split clean, leaving no particles on the fingers, cutting may take place.

Cut first with the vertical knife lengthways and crossways of the vat.

If the curd is very soft it may be advisable to leave it for five or ten minutes before using the

horizontal knife. Cut once each way with the horizontal knife.

If the whey shows .14 per cent. of acid stirring can go on for half an hour; and if scalding is adopted, heating up the contents of the vat can then be done.

The temperature to which to scald may be from 80 deg. to 90 deg., but under most circumstances the temperature of the curd and whey is merely raised to the temperature at which the rennet was added.

If the milk is too acid, scalding is not necessary as the curd can be got firm without the application of any heat. The time between scalding and draining of the whey will vary accordingly as the acid develops quickly or otherwise.

When the whey shows .17 per cent. the curd may be shovelled on to cloths, and placed on wooden racks of the cooler. The whey should be kept in the cooler so that the curd in the cloth remains partially submerged in the whey.

When the acidity reaches .2 per cent, allow the whey to drain off and cut the curd into large blocks.

Turn and pile the curd at the end of the cooler; subsequently open out and cut every twenty minutes until the acidity reaches .4 per cent., and the curd is sufficiently dry to grind.

When ready for grinding the curd should be soft, moist and mellow.

Add salt at the rate of 1 oz to every 3 lbs. of curd and thoroughly mix it in.

When the curd has fallen to a temperature of 70 deg. F. fill it into the moulds, which are lined with

thin cheese cloths, and allow the moulds full of curd to stand over-night before putting them to press.

The cheese should be turned in the moulds last thing at night before leaving. Next morning, put the cheese to press under about 1 cwt. pressure, by which time about 1 per cent. of acid will be present in the whey draining from the cheese. Gradually increase the pressure until there is about 3 cwt. altogether.

Too heavy pressure consolidates the curd and excludes the air, which is essential to the growth of blue mould.

The cheeses are turned and put back to press about mid-day; they may be taken out of press in the evening and removed to the drying room.

The cheeses are bandaged with a wide piece of cheese cloth, which is sewn on into position. Another plan is to paste the bandage on to the cheese and then replace it in the mould and put back to press for a short time to press the cloth on to it.

The yield of cheese varies according to the age at which it is sold. As much as 1¼ lbs. may be obtained from one gallon of milk if the cheese is sold at the age of three to four weeks; but as a general average 17 to 18 ozs. of cheese are obtained from a gallon of milk.

In the case of cheese kept from four to five months to go blue, the yield is usually about 14 ozs. per gallon.

Stilton shapes weigh about 12 to 14 lbs. each, and the Flats, which vary in size and shape, weigh from 5 to 14 lbs. each.

It is still a common practice to pickle cheese instead of adding salt to the curd.

In this case brine is made by dissolving salt in water until the pickle is sufficiently dense that it will allow an egg to float in it. This brine is kept in tanks and the cheese immersed in it for one to two days, but it does not salt the cheese so evenly as adding salt to the curd. After removing cheese from the moulds they should be kept in a dry atmosphere or where there is plenty of air circulating and turned once daily. If kept in a damp atmosphere lacking in ventilation the cheese may become coated with a slimy growth, which is detrimental to the flavour of the cheese.

In the case of blue moulded varieties, it is important to leave the texture of the cheese fairly open to promote the growth of mould—hence the skewering of cheese to admit air, which is sometime adopted to encourage the growth of mould.

Wensleydale Cheese Ripening Room.

CHAPTER XXIV.

(157) WHEY BUTTER.

Under normal working conditions the amount of fat in whey is ·3 per cent. and if this were all recoverable as butter, 1 lb. of butter could be produced from 33 gallons of whey.

This, however, is not the case, as to produce whey butter the whey is usually collected in large tanks and the cream allowed to rise.

The cream is skimmed off the whey after it has stood twelve and sometimes twenty-four hours, and is then scalded to a temperature of 160° F. and allowed to cool and set for twelve hours prior to churning.

Whenever cream is scalded it is essential to cool it thoroughly and harden the fats so far as possible before churning, and this can best be done by standing the vessel containing the cream in cold running water.

Where this practice of making whey butter is adopted the yield is usually very small and 1 lb. of butter only is got from 60 to 100 gallons of whey. The resulting whey butter is acid and frequently strong in flavour, and whilst it is often used for human consumption it is more commonly employed for greasing cheese in place of lard. The most econo-

mical means of producing whey butter is to carefully strain the fresh whey and pass it through a separator, and so obtain the cream as fresh as possible.

Where this is done butter of much better quality is produced and the yield is better, being approximately 1 lb. of butter from 50 gallons of whey.

The utilisation of whey for pig feeding is a subject of great importance to the farmer, and as each cow's milk made into cheese during the season will yield some 450 gallons of whey, the best means of employing whey as a food should be adopted.

Whey consists chiefly of water and sugar with a small proportion of albuminous matter and is laxative in character.

In addition to its uses for pig feeding, in factories where large quantities of whey are available it is employed to make whey cheese and milk sugar is also prepared from it.

Whey cheese is not manufactured in England but in some foreign countries and is a product of inferior quality for which there would be no market in this country.

APPENDIX FOR STUDENTS.

(158) Calculation of Cheese Pressure.

Cheeses are pressed with the object of consolidating the curd and expelling superfluous moisture. As the curd in practically every variety of cheese varies somewhat in nature when vatted and even often also in the same variety of cheese, it is essential that the pressure should be varied according to the condition of the curd at the time of pressing.

Firm acid curd requires more pressure at first and the pressure needs to be increased at a faster rate than when pressing curd of a normal character. This is because whey contains milk sugar which is all the while being converted into acid by bacteria, and unless it is quickly expelled the cheese will become very sour.

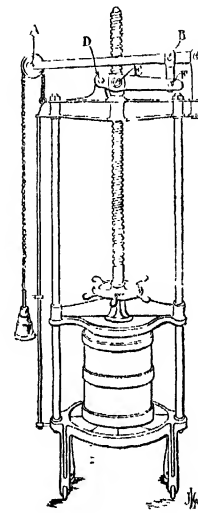
Firm curd also requires more pressure at first so as to become consolidated before it gets cold.

Insufficient pressure or pressure for too short a period produces cheese of an open, porous texture.

Pressing curd before it is sufficiently acid also causes open texture cheese as sweet curd does not consolidate well under pressure.

Excessive pressure squeezes out too much fat, and thus impoverishes the cheese.

In the case of the double lever Screw Press the following is the means by which the pressure may be calculated: Measure the distance in inches from A to C; from B to C; from D to E; from E to F respectively and find the pressure weight in lbs.



The pressure is regulated by altering the small weights at the end of the chain (the greater the weight at the end of the chain the heavier will be the pressure).

When a cheese is placed in the press without any weight on the end of the chain the pressure on the

cheese is equal to the weight of the screw, which in most presses is about 160 lbs, and this should be added to the result of any calculation.

The following is the formula for the calculation:

Example:

Distance A to C=30in.
B to C= 2in.
D to F=16in.
D to E= 2in.

$$\text{Pressure on Cheese} = \frac{\text{Distance AC}}{\text{Distance BC}} \times \frac{\text{Distance DF}}{\text{Distance DE}} \times (\text{Wt.} \times 2).$$

$$\text{Pressure on Cheese} = \frac{30}{2} \times \frac{16}{2} \times (10 \times 2).$$

Pressure on Cheese=2,400, lbs. plus weight of screw, say 160 lbs.

Pressure on Cheese=2,560 lbs, or about 22 cwt.

(159) Judging Samples of Cheese.

In the judging of cheese of any particular variety the flavour of course is the most important factor to be considered, and this should be taken in conjunction with the aroma. Generally speaking, where the cheese has an unpleasant aroma its flavour is also found defective.

The texture is often a very important point as it varies in almost every different variety of cheese and the texture should be characteristic of the particular variety.

The following points will be found useful in judging cheese :

Flavour and aroma	50
Texture, condition and evenness of salting	30
Colour	10
General appearance and finish	10
	100

(160) Yield of Cheese.

The yield of hard cheese may be pretty accurately ascertained from the percentage of fat present in the milk as the casein in milk exists in a fairly constant ratio to the fat.

In milk containing from 3 to 4 per cent. of fat there is present .66 lbs. casein for each pound of fat.

The yield of ripe cheese from 100 lbs. of milk = per cent. Fat in milk $\times$ 2.6

The yield of fresh (green) cheese from 100 lbs. of milk =per cent. Fat in milk $\times$ 2.7.

To Find Yield of Cheese (given the per centage Fat and Casein in the Milk).

Where the per centage of casein in addition to the fat in the milk is known a more accurate calculation of yield may be made.

Yield of ripe cheese from 100 lbs. milk=(per cent. Casein $\times$ 2.5) + per cent. of fat.

(161) Composition of Cheese.

The composition of cheese is very variable, and depends chiefly on the stage of ripeness at which the analysis is made.

Generally speaking, as the ripeness advances the percentage of solid matter in the cheese increases owing to the reduction of the moisture contents.

AVERAGE COMPOSITION.

	Water.	Fat.	Casein, etc.	Sugar and Extractives as Lactic Acid, etc.	Mineral Matter (including salt).
Cheddar, ripe (Lloyd)	35.58	31.33	29.12	included in figure for casein.	3.97
Stilton, blue ripe (Voelcker) ..	32.18	37.36	24.31	2.22	3.93
Wensleydale (as sold fresh 4 to 8 weeks old)	34.70	31.00	28.1	2.5	3.7

THE HARD PRESSED VARIETIES of cheese contain when sold according to their age, etc., from 27 to 36 per cent. of water, 27 to 33 per cent. of fat, 25 to 32 per cent. casein, and 1 to $5\frac{3}{4}$ per cent. of sugar and lactic acid.

The mineral matter runs from $2\frac{1}{2}$ to 3 per cent. without the salt added in the process of manufacture.

The figures for Stilton and Wensleydale Cheese are given as representing the fresh and blue ripe stages of the BLUE MOULDED VARIETIES.

SOFT CHEESE contains from 40 to 50 per cent. water, 22 to 24 per cent. of fat and 20 to 23 per cent. of casein, etc.

(162) Average Composition of some other Dairy Products.

	Water.	Fat.	Casein and Albumen.	Milk Sugar.	Ash.
Milk	87.55	3.6	3.5	4.60	.75
Milk Separated	90.39	.10	3.90	4.85	.76
Cream (thin) suitable for Buttermaking	63.38	28.20	3.25	4.52	.65
Cream (thick), suitable for sale	48.38	45.30	3.05	2.67	.60
Cream, Devonshire Clotted	33.29	60.25	4.76	1.20	.50
Buttermilk	94.44	.20	3.56	*4.10	.70
Butter	11.9	85.00	.6	.5	†2.00
Whey	93.26	.30	.89	4.9	.65

* With lactic acid. † Including salt.

(163) Measures of Capacity.

5 ounces of water = 1 gill.
2 pints = 1 quart.
1 litre = 1000 c.c.
1 litre = 1.76 (1¾) pints
4 litres = 1 gallon approximately.
100 litres = 22 gallons.
1 gallon of water = 10 pounds
4 gills = 1 pint.
4 quarts = 1 gallon.
1 c.c of water at 4° C. = 1 gram.
1 c c. = 17 minims or drops.
3 55 (3¾) c c = 1 drachm
1 gram = 15.432 (15½) grains troy.
28 grams = 1 ounce troy.
1 gallon milk = 10.32 lbs. average or 10 lbs. 5 ozs.

1 cubic foot of water = 1000 ounces or 6¼ gallons.
1 barn gallon = 17 pints or 2 imperial gallons and a pint
1 Winchester quart = 80 ozs. or ⅘ imp gallon.
1 railway churn of milk = 17 imp. gallons or 8 barn gallons.

FLUID MEASURE.

60 minims or drops = 1 fluid drachm.
8 drachms = 1 fluid ounce.
20 ounces = 1 pint.
8 pints = 1 gallon.
1 ounce = 2 tablespoons.
1 drachm = 1 teaspoon.

(164) Table showing Acidity at Different Stages in the Manufacturing Process of several Varieties of Cheese.

Variety.	Percentage Acid at Rennetting.	Rennet Test.	Percentage Acid at Cutting.	Whey Drawn		Grinding.		Percentage Acid at Vatting.	Percentage Acid from Press.
				Percentage Acid	Hot Iron Test.	Percentage Acid.	Hot Iron Test.		
		Secs							
Cheddar	.2–.22	20–22	.14–.15	.19–.2	¼-in.	.85	1½-1¾ in. fine threads	.8–.9	.9–1%
Lancashire	.18	—	.12–.13	.13–.14		.26 fresh Curd		.8–.9 *mixed Curd	1–1.25
Cheshire :									
Early Ripening ..	.23	20	.14–.15	.2	¼-in.	.7	1¼-in.		†1.2
Medium Ripening ..	.2	20–22	.14	.18	¼-in.	.4–.5	1-in.		1.0
Late Ripening ..	.18	24	.14	.16	⅛-in.	.4	¾-in.		.9
Leicester	.19–.2	23–24	.12–.13	.15–.16	⅛–¼-in.	.35	¾-in.		.5
Derby	.21	22	.12–.13	.15	⅛-¼-in.	.5	¾-1-in.		.6
Caerphilly	.18–.2	—	.12–.13	.15–.16		.4			
Stilton	.18–.19	—	.11–.12	.125–.13		—		.4–.5	
Wensleydale	.2	—	.14	.16–.17		.4			

* Mixed curd, fresh containing .26 per cent. acid. and curd, 24 hours old, containing 1.4–1.5 per cent. acid mixed in proper proportions to yield .8–.9 per cent. of acid.

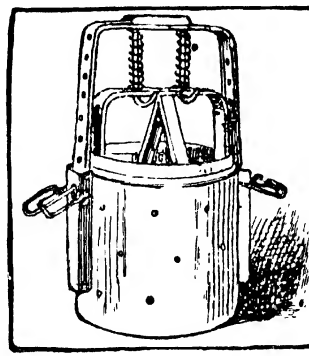
† Cheshire Cheese put to press twelve hours after vatting.

INDEX

References are to the numbers of paragraphs

Headley Brothers, Printers, 18, Devonshire Street, E.C.2; and Ashford, Kent.

CHEESE-MAKING



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" " 2	6 lbs.	15s.
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